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DEVELOPMENT OF LOWER COST CRUSH ELEMENT FOR M577 FUZE.(U)

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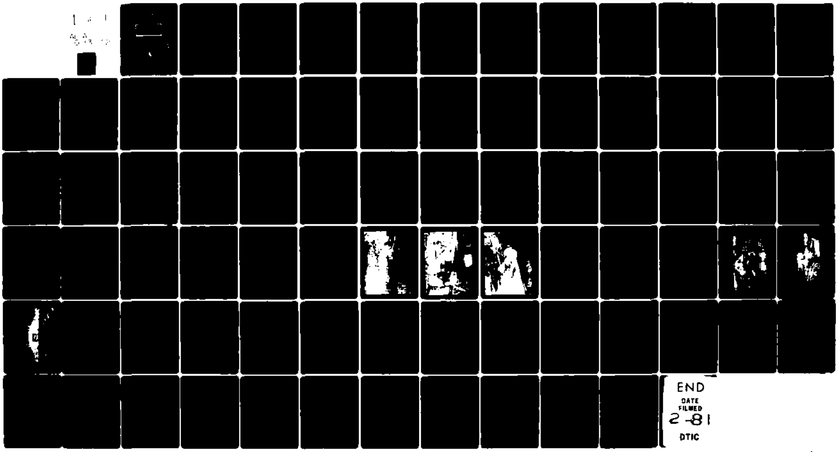

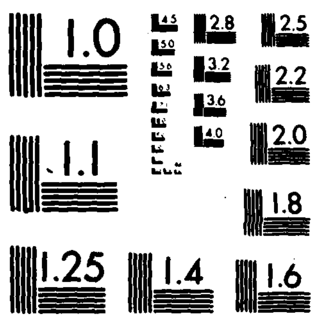

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LEVEL II

DEVELOPMENT OF LOWER COST

CRUSH ELEMENT FOR M577 FUZE

BY

H. J. HARMER

Hamilton Technology, Inc.

P.O. Box 4787

Columbia Avenue

Lancaster, PA 17604

17 November 1980

Final Report

Period June 1979 - October 1980

Prepared for

ARRADCOM

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

THIS REPORT DESCRIBES THE WORK ACCOMPLISHED BY HTI FOR ARRADCOM UNDER TASK NO. 1 OF CONTRACT DAAK10-79-C-0169 FROM JUNE 1979 THROUGH OCTOBER 1980. THE OBJECT OF THIS TASK WAS TO REDUCE COSTS BY REPLACING THE CRUSH ELEMENT AND CRUSH RETAINER IN THE M577 FUZE WITH A CRUSH TUBE AND RETAINER PLUG. THIS RESULTED IN A SAVINGS OF $0.525 PER FUZE.

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CRUSH ELEMENT FOR M577 FUZE,

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BY

(10) H. J./HARMER

Hamilton Technology, Inc.

P.O. Box 4787

Columbia Avenue

Lancaster, PA 17604

(11) 17 November 1980

(9) Final Report.

Period June 1979 - October 1980,

Prepared for

ARRADCOM

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1.0 INTRODUCTION

This report describes the work accomplished by Hamilton Technology, Inc. for ARRADCOM under Task No. 1 of Contract DAAK10-79-C-0169 from June 1979 through October 1980.

The object of this task was to evaluate materials and manufacturing process changes in an effort to lower the costs associated with the mass manufacture of the M577 Fuze Crush Element (9236518).

Preliminary Investigation of several design configurations showed a brass thin-wall cylindrical Crush Tube expanded by a special Retainer Plug to be the most promising. These two components replace the present Crush Element and Crush Retainer and result in a savings of $0.525 per fuze.

Drawings of the present design and new design Setting Key Assemblies and their detailed parts are shown in Appendix A.

2.0 SUMMARY OF ACCOMPLISHMENTS

A cylindrical thin-wall brass tube expanded by a taper plug was shown to be the best of several designs considered for improved replacement of the Crush Element. Compression tests were run to develop dimensions, tolerances and hardness of materials. Tests were then performed on Setting Key Assemblies to verify the assembly method, energy absorption, and effects of damaged Setting Keys. Shipping and Handling tests and Ballistic tests were performed on fuze assemblies. A Setting Key Assembly was developed which will save $0.525 per fuze.

3.0 CONCLUSIONS AND RECOMMENDATIONS

The new design Crush Tube and Retainer Plug passed all of the required tests except the Ballistic Air Gun Test at 30,000 G's. The test results and calculations indicate they will safely withstand 23,000 G's. Extensive tests were performed to verify acceptable performance of the new design in Setting Key Assemblies and with variations in piece-part tolerances.

The new design saves $0.525 per fuze.

It is recommended the new design Crush Tube and Retainer Plug be incorporated into the M577 Fuze Technical Data Package.

4.0 PRELIMINARY DESIGNS

Several designs of the Crush Element were initially proposed, and are shown in Fig. 1. Calculations indicated that even the simplest of these designs (Fig. 1a) would require costly development of tools for about five deep-drawing steps in addition to final trimming to length. Samples of existing drawn eyelets, Fig. 1d, were subjected to compression tests and the load-deflection curves showed buckling at several nodes during the .400 inches of deflection and 100% change in load values from peak-to-valley of the nodes.

Four designs of thin-wall cylindrical tubes, Fig. 2, were then explored. Tubes of 3003-H14 Aluminum (.405 O.D. x .016 wall) and 70-30 Brass, 3/4H (.400 O.D. x .007 wall) were obtained. Samples of the plain cylinder design, Fig. 2a, were compression tested first. The aluminum tube crushed with 2-3 nodes but crush loads and peak-to-valley load variation exceeded the 190-305 lb. limits given on the Crush Element drawing. The brass tube crushed with 6 nodes; the peak-to-valley load variation was about 200 lb. and most of the valleys were above the 190-lb. limit, but the peaks exceeded the 305 lb. limit by about 60 lbs. Samples of the Necked Ring design, Fig. 2b, consisted of necking down the brass tube O.D. at 8 circumferential rings with no appreciable reduction in wall thickness, and samples of the Scored Ring design, Fig. 2c, consisted of cutting 9 circumferential grooves .002 - .004 deep on the brass tube O.D. The brass tube with Scored Ring design, Fig. 2c, showed the best load-deflection curve of the three designs, Fig. 2a, b, c. This design crushed with 8 nodes and the entire curve was within the load requirements, except for 2 nodes exceeding the 305-lb. limit by 15 lb. Samples of the Plain cylinder with Retainer Plug, Fig. 2d, consisted of forcing a tapered retainer plug through the cylindrical tube, thus expanding the tube. Retainer plugs .125 long with various diameters and tapered angles were tested in samples of the aluminum and brass tubes. The best results were obtained using 70-30 Brass, 3/4 H tube, .406 O.D. x .014 wall x .580 lg. with Retainer Plug .393 dia. x 30° tapered.

All of the load-deflection curves for the Plain Cylinder with Retainer Plug design, Fig. 2d, showed the load increased to a maximum value in the first .050-.100 inch of deflection, then remained fairly constant throughout the remaining deflection. Since this design showed the most promise of meeting the Crush Element requirements, it was decided to pursue further tests and evaluations.

5.0 DEVELOPMENT OF CRUSH TUBE & RETAINER PLUG

5.1 Compression Tests:

The Compression Tests were performed in a Tinius Olsen Electmatic Universal Test Machine with recorder and deflectometer, at not greater than .10-inches-per-minute deflection rate, and at ambient temperature. Fig. 3 shows a typical compression test setup. Load-deflection test curves are shown in Appendix B.

Initial compression tests were run using a Crush Tube (70-30 Brass, 3/4 hard) .406 O.D. x .014 wall x .580 long with Retainer Plug (416 Stainless Steel, Condition T) .393 O.D. x 30° taper with no extension below the taper. On some of these tests the Retainer Plug tilted causing a decrease in load, and the Crush Tube O.D. expanded until it touched the Key I.D. causing an increase in load. A skirt or extension was added below the taper on the Retainer Plug and a smaller diameter Crush Tube (.375 O.D. x .014 wall) and Retainer Plug (.385 Dia. x 20°) were used to correct this condition. The smaller diameter tube and plug required changing the taper to 20° on the Retainer Plug.

5.1.1. Dimensional Tolerances -

The effects of dimensional tolerances of the Crush Tube and Retainer Plug on the compression load was determined by running compression tests on the same size tubes (70-30 Brass, 3/4H, .375 O.D., .014 wall, .650 long) with various diameter Retainer Plugs. The compression load increased rapidly in the first .100 inch of deflection and then remained fairly constant for the remaining .305 inch of deflection. The constant load for the various diameters of Retainer Plugs was as follows:

Dia. - Inches	Load - Pounds
.3904	338
.3876	277
.3864	255
.3840	244
.3809	244

This data indicates the tolerances on the Retainer Plug O.D. (.3840 - .0005) and the Crush Tube I.D. (.347 ± .002) and wall (.014 ± .001) will not adversely affect the compression load.

5.1.2 Hardness of Crush Tube -

The effects of Crush Tube hardness variations on the compression load was investigated. Three 1-foot lengths of 70-30 Brass Tube, 3/4H, (.375 O.D., .014 wall) were used. One tube was used in the 3/4-hard condition; one tube was drawn to approximately 1/4-hard condition; and, the other tube was fully annealed. Tensile test and compression test samples were cut from each of the 3 tubes and then tested. The tensile yield load and compression load for these 3 conditions of hardness were as follows:

Condition	Tensile Yield - Lb.	Compression - Lb.
3/4 Hard	1070	250
1/4 Hard	400	212
Annealed	300	205

The annealed and 1/4-hard samples had a greater spread in test results, with some of the compression loads falling below the 190-lb. minimum requirement. The 3/4-hard samples had a narrower spread in compression loads and all were in the middle of the 190-305 lb. requirement limits. It should be noted that the hardness of the 3/4-hard samples was R_B 80, which is the minimum shown in ASTM B135, Alloy 260, hard-drawn Brass tubing. This data indicates that "hard drawn" tubing should be used for the Crush Tube.

5.1.3 Setting Key Assembly Tests -

Compression tests were run on the new design Setting Key Assemblies. Crush Tube and Retainer Plug were installed in the Setting Key, compressed to the required dimension, and the Setting Key diameter crimped. The Crush Tube (70-30 Brass, 3/4H, .375 O.D., .014 wall, .565 long) and Retainer Plugs (.416 SS, .384 Dia., 20^{o} taper, with skirt) were made on production tools and the Setting Key Assembly operations performed on production machines. Clutch Drive Sleeves, P/N 9236520, were used in place of the test load bar and production Setting Keys were used in place of the test key shown in Fig. 3. At about .200-inch deflection, some samples showed a momentary increase in load. This was caused by the top of the Crush Tube hitting the top of the flats on the sides of the Clutch Drive Sleeve. The Crush Tube length was increased to .665 inches and this eliminated the condition. It was also found that the compression loads on these crimped Setting Key Assemblies was about 25-lbs. higher than on Setting Key Assemblies not crimped, due to friction between the Key and Drive Sleeve.

5.1.4 Repeatability Tests -

Fifty (50) samples of the final design of Crush Tube, P/N 9236730, and Retainer Plug, P/N 9236731, were compression tested for repeatability of load-deflection curves. All samples were made using production tools and methods. Twenty-five (25) samples were tested in open-ended test keys with test bars, as shown in Fig. 3, without pre-crushing to the .015 dimension required in Note 2 of Setting Key Assembly Drawing 9236729. The other twenty-five (25) samples were assembled per Setting Key Assembly Drawing 9236729 including pre-crushing the Crush Tube, reducing the diameter and forming tabs on the Setting Key, and Clutch Drive Sleeves installed and then compression tested. The test curves of all twenty-five (25) samples not pre-crushed fell within the load-deflection requirements of Crush Element Drawing 9236518, except at the 190-lb. .050" point, where it took about .055"-.073" deflection before the load reached 190-lbs. This will not affect function in the fuze since pre-crushing during assembly exceeds this point. The test curves (Appendix "B") of the (25) samples pre-crushed were about 25-lb. higher than those samples not pre-crushed, due to friction between the Clutch Drive Sleeve and crimped end of the Setting Key. Hence the maximum load exceeded the 305-lb. limit on a few samples. If the Key-Sleeve friction force is subtracted, the loads on all (25) pre-crushed samples fall well within the 190-305 lb. limits.

5.2 Energy Drop Tests:

The purpose of this test was to compare the energy absorption of the present and new designs of Setting Key Assemblies. The test setup was similar to the Compression Test Setup, Fig. 3, except a 5-lb. weight was dropped from various heights onto the test bar. Nine (9) samples of the present design Crush Element and Crush Retainer, and nine (9) samples of the new design Crush Tube and Retainer Plug were tested. All samples were pre-crushed before inserting into the test key. A separate sample of each design was tested at 2-1/2" increments of drop heights from 7.25" up to 27.50". The deflection of each sample was measured and the dropped weight energy calculated. These values, plotted in Fig. 4, show the two designs to be comparable.

5.3 Damaged Fuze Test:

The purpose of this test was to determine the effects of a damaged fuze nose on the function of the Setting Key Assembly. Five (5) new design Setting Key Assemlies were installed in inert M577 Fuze Assemblies and attached to inert 105mm Projectiles. These assemblies were dropped in 45^{0} nose-down attitude from various heights onto a steel plate. The Setting Key Assemblies were removed and the amount of compression measured.

Sample No.	Drop Ht.-Ft.	Compression-In.
1	2.50	.022
2	3.25	.052
3	5.0	.100
4	5.0	.061
5	5.0	.061

The Clutch Drive Sleeve on Sample No. 3 had tilted in the Key. All Key Assembly samples were then compression tested. Compression loads on Samples No. 1, 2, and 5 were within the 190-305 lb. limits. Loads on Samples No. 3 and 4 were within limits until the last .050" of compression when the load increased somewhat above the 305-lb. limit.

5.4 Liquid Impact Simulator

This piece of test equipment was intended to be used to perform preliminary tests in the laboratory on raindrop impact with Setting Key Assemblies. Drawings were obtained of a similar piece of equipment built and operated by NSWC (NOL). HTI proceeded to build such a piece of eqqipment, but found the velocity measuring instrumentation was no longer available. Substitute instrumentation was tested, but was not successful. ARRADCOM and HTI agreed to stop further efforts on this test equipment.

6.0 FUZE ASSEMBLY TESTS

The new design Setting Key Assemblies were built and installed in M577 Fuze Assemblies using production tools and processes. Sufficient quantities were built to perform the following tests required in the contract.

6.1 Jolt and Jumble Test -

Six (6) live Fuze Assemblies were built and tested per MIL-STD-331, Tests 102.1 and 101.2. All units were examined after testing and found to be safe to handle.

6.2 Static Propagation Test -

Thirty (30) live Fuze Assemblies were built and tested, with the SSD armed, per MIL-F-50983, Para. 3.7. All units functioned in accordance with the specification.

6.3 Five-Foot Drop Test -

Ten (10) live Fuze Assemblies (S/N 70-79) were built and tested per MIL-STD-331, Para. 111.2, two each in nose down, base down, 45^{o} nose down, 45^{o} base down, and horizontal attitude. All units were X-rayed after testing and were shown to be safe to handle.

These (10) units were then subjected to the Ballistic P.D. Tests (see Section 6.5).

6.4 Ballistic Air Gun Test -

Twelve (12) Inert Fuze Assemblies (S/N 1-12) containing the new design Setting Key Assembly and four (4) Inert Fuze Assemblies (S/N 13-16) containing the present design Setting Key Assembly were shipped to Picatinny Arsenal for Setback (20,000-30,000 G's) testing in the Air Gun. Test data is shown in Appendix C.

Upon completion of the tests, the Ogive was removed and the fuze elements examined. It was noted that the Firing Plates had been bent on three of the four present design units (S/N 13, 15, 16) and on nine of the twelve new design units (S/N 4-12). The Firing plate had deflected enough to hit the M55 Detonator on six of the new design units (S/N 5-9, 12). Although the large flange of the Setting Key had obviously hit the Firing Plate, examination showed the flange to be over .100" above the Firing Plate after the test. Measurements of the compression of the Drive Sleeve and Setting Key Assembly showed about .103" on the present design and .138" on the new design for those units subjected to more than 28,000 G's (S/N 3-16). The largest deflection on these units was .149", but per detailed drawing dimensions, the Setting Key flange must travel .233 +.0775 -.0135 or a minimum of .2195" before it will cause the Firing Plate to hit the detonator. This indicated some deflection and springback was occurring on other parts of the Fuze Assembly below the Clutch Drive Sleeve. Load-deflection tests were made on a Fuze Assembly without the Ogive, Setting Key Assembly and Drive Sleeve. Results were as follows:

Load-Lb.	Deflection-In.
500	.105
1000	.115
1500	.151

At 30,000 G's, the mass of the Setting Key Assembly and Drive Sleeve, plus other parts of the fuze, will exert a force sufficient to cause the .100" deflection and springback of fuze parts below the Firing Plate and account for the gap between the Setting Key Flange and the Firing Plate after the test. Calculations show that after the Setting Key has deflected .214 + .028 inches it loses lateral support in the Ogive and can tilt, causing its flange to hit one side of the Firing Plate sooner than the other side. This condition was noted on some of the test fuzes since one side of the Firing Plate was bent more than the other side.

The Air Gun Test Data (Appendix C) shows that samples of the New Design Setting Key Assembly will deflect the Firing Plate enough to hit the M55 Detonator at 28,638 G's, but will not hit at 26,258 G's. However, calculations (Appendix D) based on the minimum load the Crush Tube will support indicates the Crush Tube will withstand 23,059 G's before starts moving down over the Retainer Plug.

6.5 Ballistic PD Test -

Twenty (20) live Fuze Assemblies (S/N 50-59) plus the ten (10) live Fuze Assemblies (S/N 70-79) from 5-ft. Drop Test (Section 5.3), were shipped to Yuma Proving Grounds, Yuma, Arizona, and Ballistic PD tested. Test data (Appendix E) shows that all units functioned on the target.

6.6 Ballistic Water Impact Test -

Twenty-five (25) live Fuze Assemblies (S/N 17-41) containing the new design Setting Key Assembly and eight (8) live Fuze Assemblies (S/N 42-49) containing the present design Setting Key Assembly were shipped to Picatinny Arsenal for Ballistic Water Impact Testing. All units had the Lever Assembly (9236540) omitted from the SSD to enable quick arming of the fuze. The test setup and test data are given in Appendix F. The present design units were not required for the test, but were used only for comparison. Only two of these (S/N 42-43) were tested, and both functioned at the water target. All (25) of the new design units functioned at the water target. Acceptance criteria is at least 20 of 25 units must function at the water target.

6.7 Ballistic Rainfield Test -

Fifty (50) live Fuze Assemblies (S/N 80-129) containing the new design Setting Key Assembly and eight (8) live Fuze Assemblies (S/N 130-137) containing the present design Setting Key Assembly were shipped to Holloman Air Force Base for Ballistic Rainfield Tests. All units had the Lever Assembly (9236540) omitted from the SSD to enable quick arming of the fuze. The test plan, test setup and test data are given in Appendix G. One M557 Control Fuze (which was to function in the Rainfield) was fired before and after each group of five M577 Test Fuzes. A total of (15) M557 Control Fuzes, (50) M577 Test Fuzes (new design), and (8) M577 Test Fuzes (present design) were fired. The I.R. film data showed the fuzes functioned as follows:

	M557 Control	M577 New	M577 Present
Rainfield	6		
Target	7	37	4
No Indication	2	13	4
TOTAL:	15	50	8

The first 10 rounds, which included (2) M557 Control Units and (8) M577 New Units, missed the target and hit the bunker, and are shown as "no indication." The remaining (9) "no indication" units are believed to have buried in the bunker and shielded the flash from the camera.

7.0 COST AND WEIGHT COMPARISON

The new Setting Key Assembly involves only the replacement of the present Crush Element and Crush Retainer with the new Crush Tube and Retainer Plug. Assembly operations are the same as for the present Setting Key Assembly, hence only the cost of the two detail parts is affected.

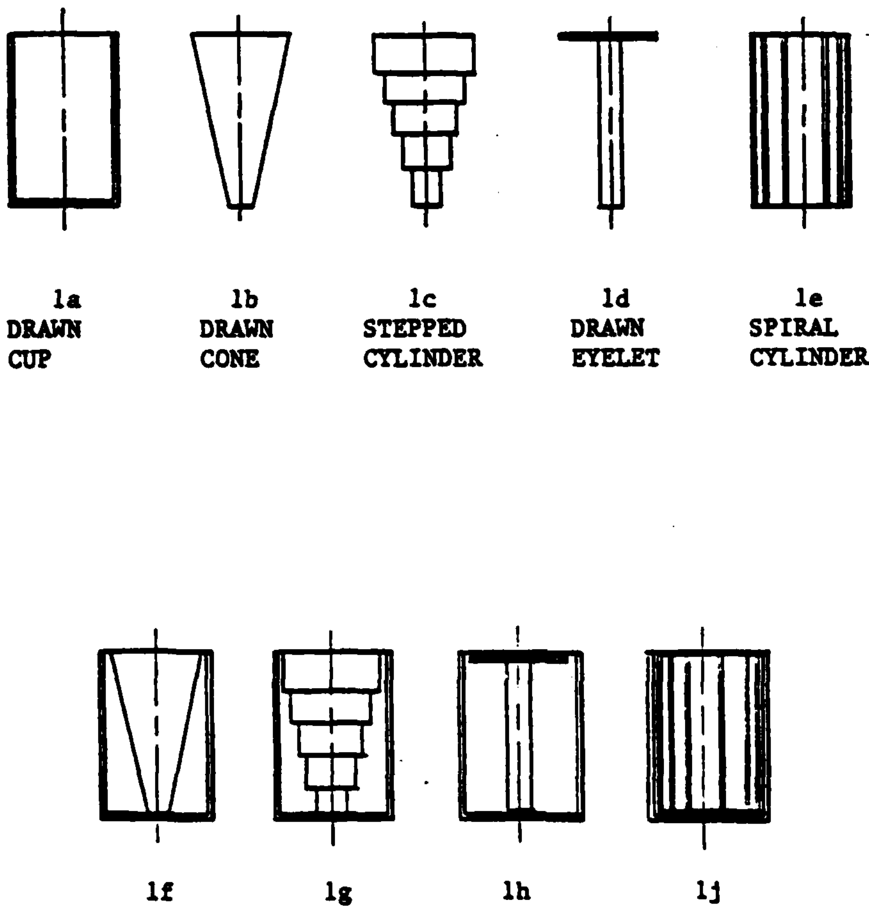
7.1 Cost Comparison -

Replacing the present Crush Element and Crush Retainer with the new Crush Tube and Retainer Plug saves $0.525 per fuze, including labor, overhead and material.

7.2 Weight Comparison -

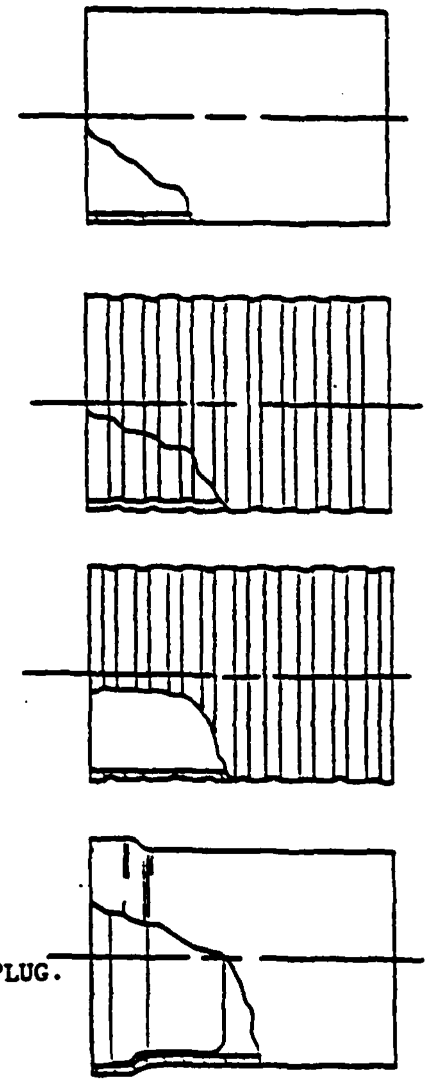
	New		Present
Crush Element			.335
Crush Tube	1.450		
Crush Retainer			.520
Retainer Plug	2.620		
	4.070	-	.855 = 3.215 gm.

Weight Increase per Fuze = 3.215 gm. = .0071 lb.



COMBINATIONS OF 1a-1e

FIG. 1



a. PLAIN CYLINDER

b. NECKED RINGS

c. SCORED RINGS

d. PLAIN CYLINDER WITH RETAINER PLUG.

FIG. 2

COMPRESSION TEST SETUP

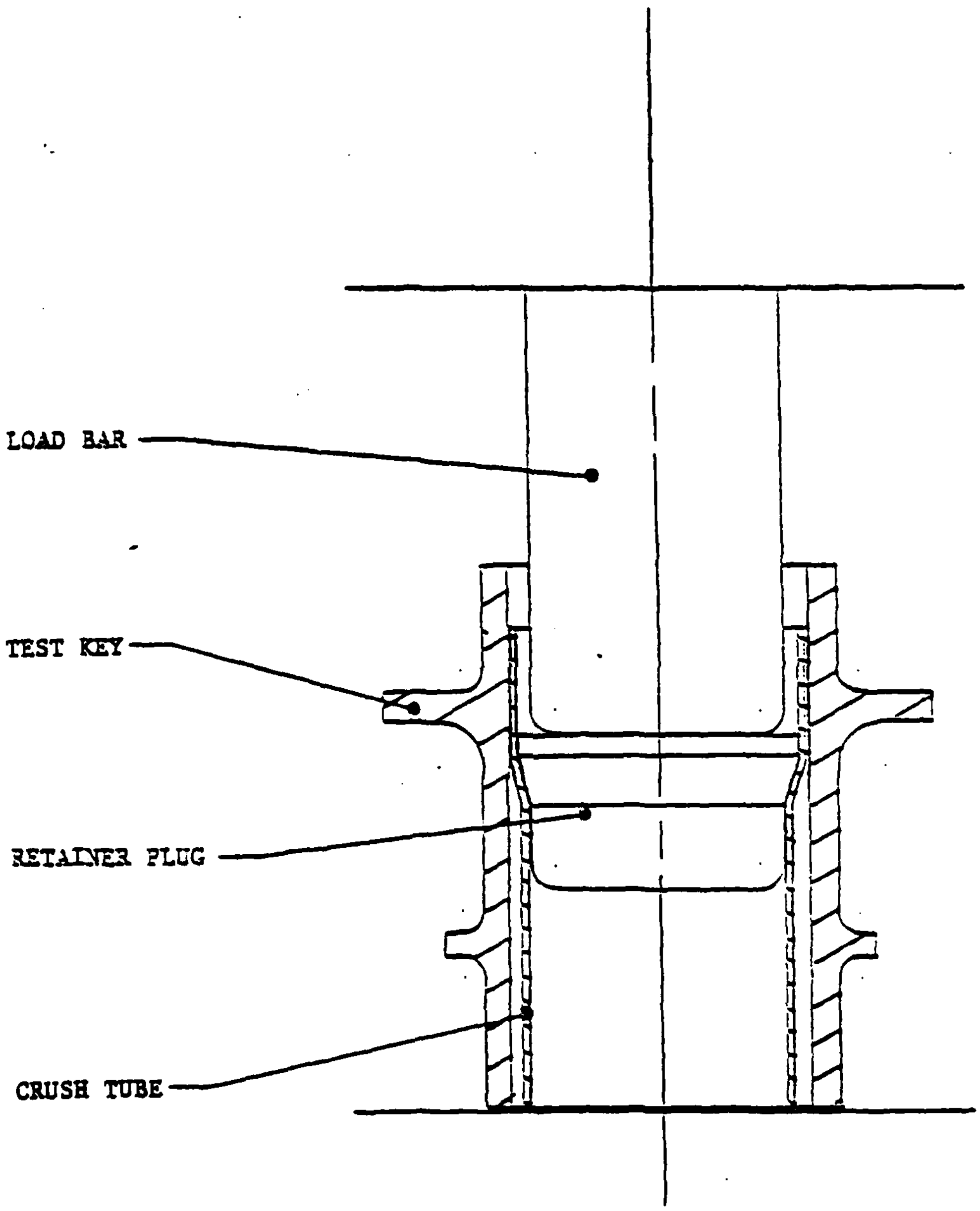


FIG. 3

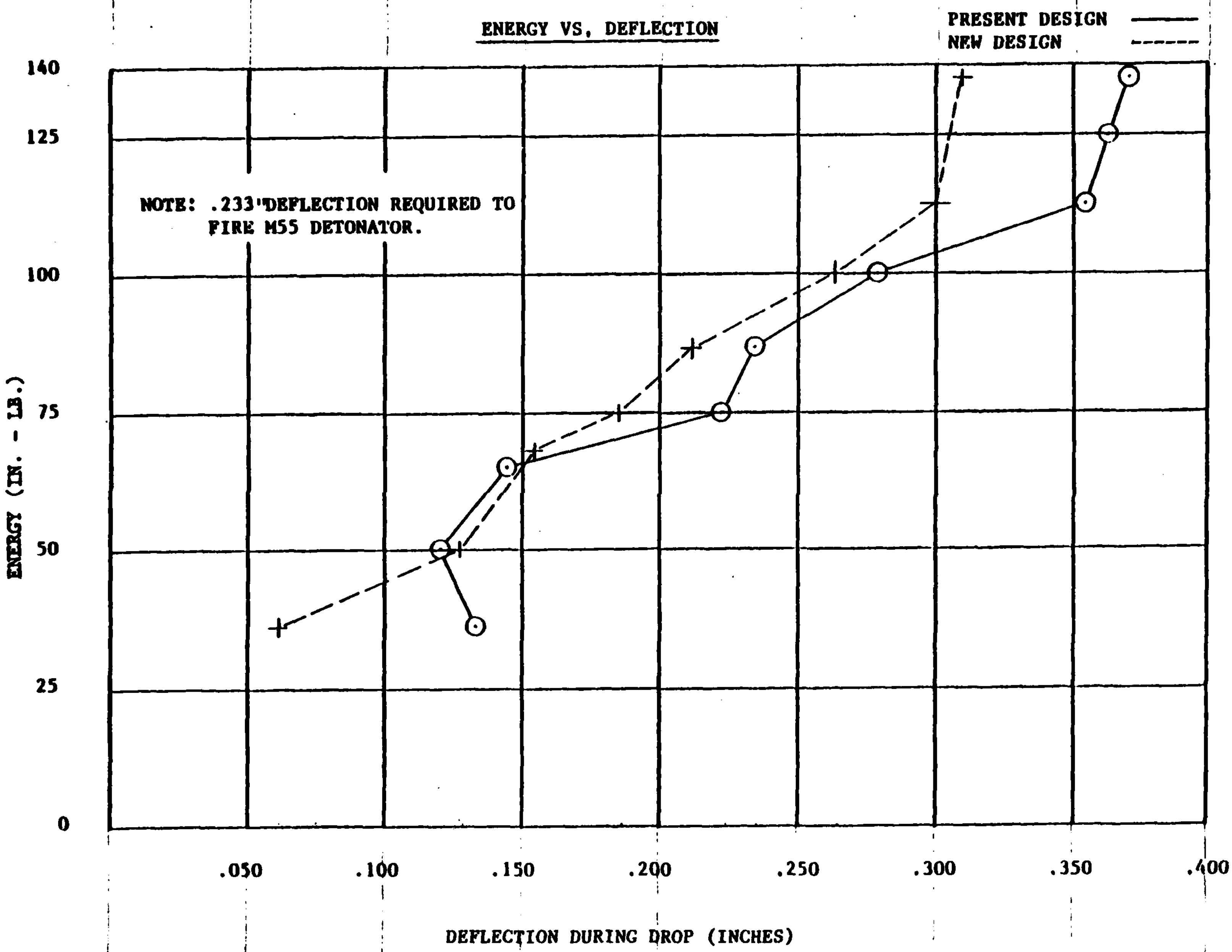

ENERGY VS. DEFLECTION
PRESENT DESIGN
NEW DESIGN
NOTE: .233" DEFLECTION REQUIRED TO FIRE M55 DETONATOR.
ENERGY (IN. - LB.)
140
125
100
75
50
25
0
.050
.100
.150
.200
.250
.300
.350
.400
DEFLECTION DURING DROP (INCHES)

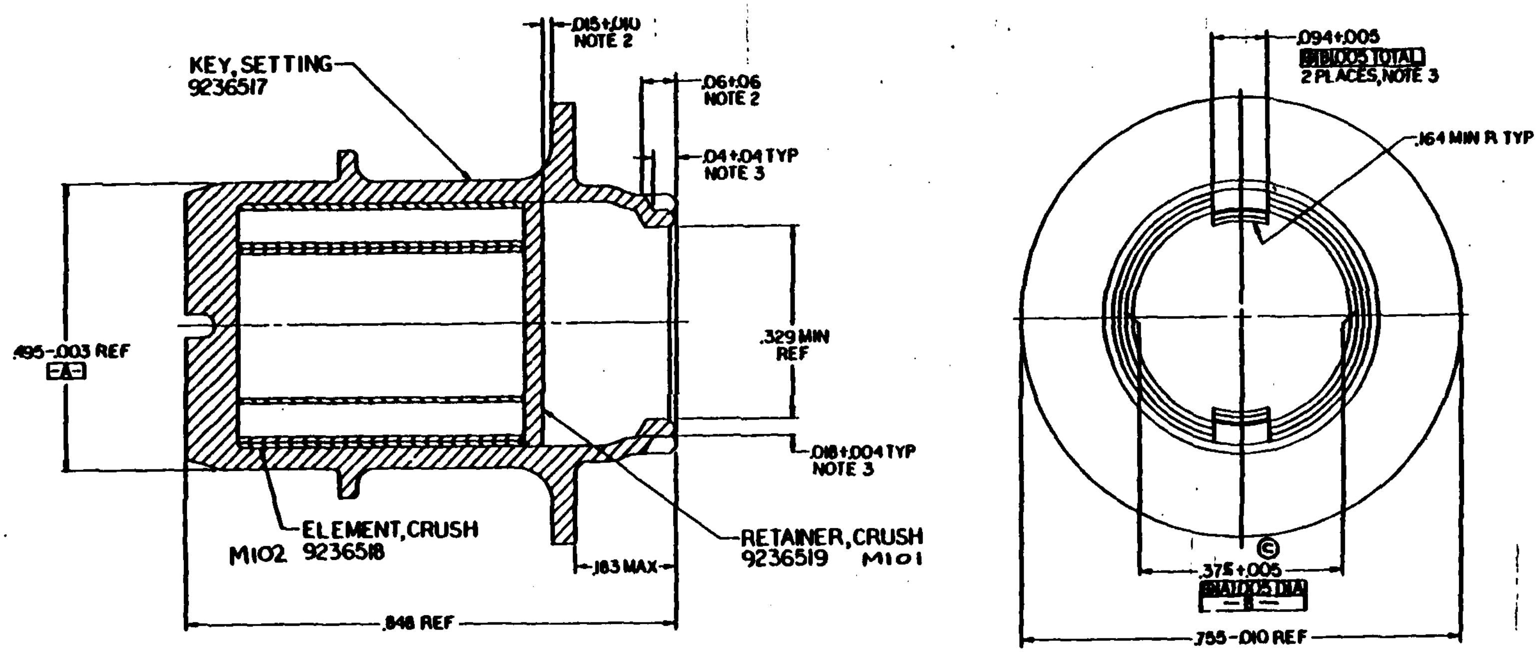
FIG. 4

APPENDIX "A"

Drawings:

9236516	SETTING KEY ASSEMBLY (PRESENT)
9236517	SETTING KEY
9236518	CRUSH ELEMENT
9236519	CRUSH RETAINER
9236729	SETTING KEY ASSEMBLY (NEW)
9236730	CRUSH TUBE
9236731	RETAINER PLUG

NOTES:-
1-SPEC MIL-A-2550 APPLIES.
(B) 2-INSERT AND COMPRESS CRUSH ELEMENT WITH RETAINER IN PLACE TO DIMENSION GIVEN PRIOR TO REDUCING SETTING KEY TO .375±.005.
(C) 3-FORM TABS AS SHOWN, 2 PLACES.



FOR ASSOCIATED LIST, SEE 9236516

PART NO. 9236516

NEXT ASSY	USED ON
9236700	FUZE, M582
9236500	FUZE, M577
APPLICATION	

DO NOT SCALE DRAWING

ORIGINAL DATE OF DRAWING 28 AUG 1972

CHECKER P.B · ENGR BROWN · ENGR T.H.C · ENGR E.BABICH

HARRIS H. HOGANSON

DANIEL TARAVELLA

U.S. ARMY ARMAMENT COMMAND, PICATINNY ARSENAL, DOVER, NEW JERSEY 07801

SETTING KEY ASSEMBLY

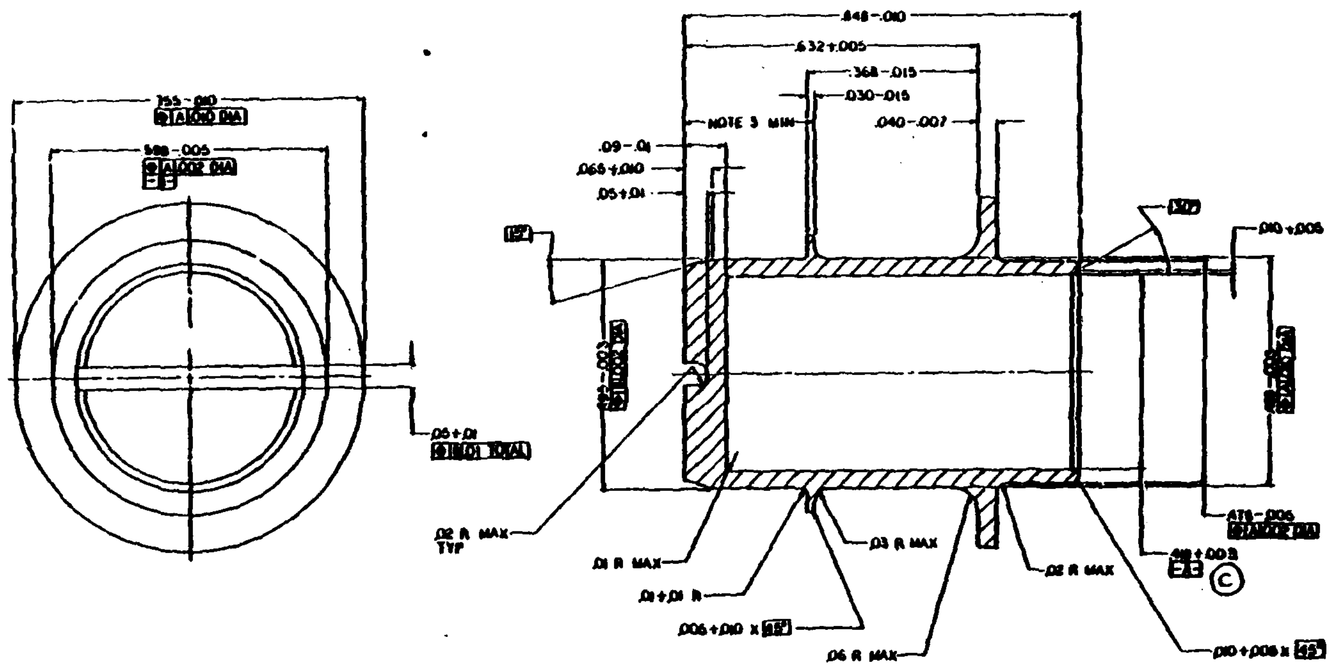
SIZE D · CODE IDENT NO. 19203 · 9236516

SCALE 10/1

DUPLICATE ORIGINAL

NOTES:-
1- SPEC MIL-A-2550 APPLIES.
(4) 2- MATERIAL:-ALUMINUM-ALLOY BARS, RODS AND WIRE, ALLOY 2024 TEMPER T4 ASTM B211.
3- PROTECTIVE FINISH:-FINISH 7.2.2 OF MIL-STD-171, BLACK NO. 37038, MANDATORY ON ALL EXTERNAL SURFACES TO MINIMUM LENGTH INDICATED, OPTIONAL ON BALANCE OF PART, EXCEPT
(6) PART SHALL BE EXPOSED TO A SALT SPRAY FOR A MINIMUM OF 96 HOURS IN LIEU OF 336 HOURS PER PARAGRAPH 4.6.3.1 OF MIL-A-8625. SALT SPRAY REQUIREMENTS APPLY TO EXTERNAL SURFACES INDICATED.
4- UNLESS OTHERWISE SPECIFIED FILLETS ARE TO BE .005 R MAX AND CORNERS ARE TO BE .005 R MAX OR .005 MAX X 45° BASIC.
5- 125/ ALL OVER.

—	EHM72L0146-1 (REL)	[illegible]	[illegible]
A	MOA7300402-1/05-10-73	[illegible]	[illegible]
B	MOA 7300961-1/08-27-73	11-25-73	[illegible]
C	MOR 7600107-1/2-3-76	3-3-76	[illegible]



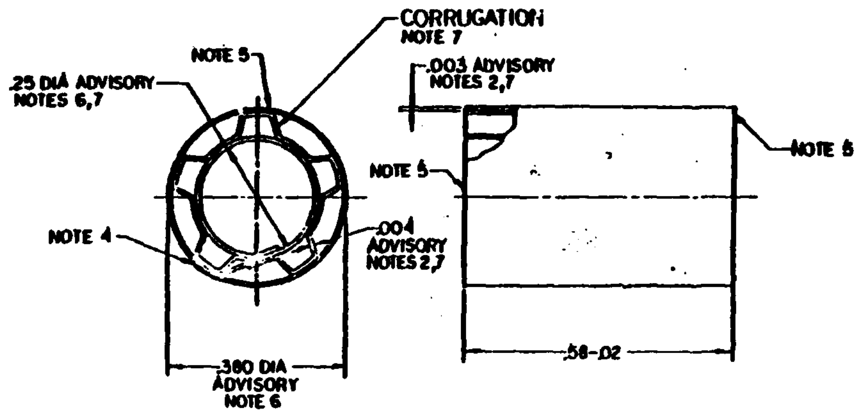
PART NO. 9236517

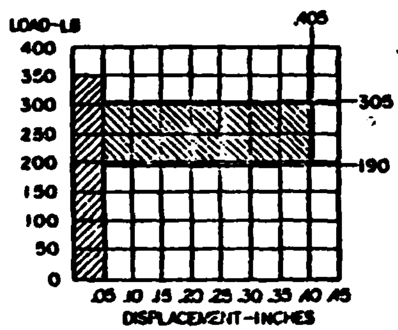
	FUZE, M582	DO NOT SCALE DRAWING	28 AUG 1972	KEY, SETTING M
9236516	FUZE, M577			F 19203 9236517
NEXT ASSY	USED ON			
APPLICATION				

NOTES:-

1 - SPEC MIL-A-2550 APPLIES.
2 - MATERIAL:-ALUMINUM-ALLOY,SHEET AND PLATE, ALLOY 5052, ASTM B209 (ADVISORY:- FABRICATE FROM 2 PIECES).
3 - ALTERNATIVE MATERIAL:-ALUMINUM-ALLOY 5052,PLATE AND SHEET, SPEC QQ-A-250/8.
4 - BOND ALL OVERLAPPING JOINTS AND/OR SEAMS AND INDICATED AREAS FOR ENTIRE LENGTH (58-.02), ALSO BETWEEN COILS OF CASE AND TUBE AS REQUIRED WITH ADHESIVE, EPOXY RESIN, TYPE III, SPEC MMM-A-134.
5 - ADHESIVE ON INDICATED SURFACES SHALL NOT BE CAUSE FOR REJECTION.
6 - ROUNDNESS AND CONCENTRICITY OF .360 DIA AND .25 DIA WITH RESPECT TO EACH OTHER IS IMMATERIAL.(NOTE 8)
7 - ADVISORY DIMENSIONS NEED NOT BE GAGED (NOTE 9).
8 - OUT OF ROUNDNESS OF .360 DIA MUST FIT LOOSELY INTO .418 DIA HOLE.
9 - LOAD DISPLACEMENT RELATIONSHIP MUST LIE WITHIN SHADED AREA OF REQUIREMENT CHART WHEN SUBJECTED TO TEST ILLUSTRATED IN FIGURE I (NOTE 10).
10 - APPLY AXIAL STATIC LOAD AT RATE NOT GREATER THAN .10 INCHES PER MINUTE OF ROD TRAVEL.

LTR	DESCRIPTION	DATE	APPROVED
-	ERR 72003461 (REL)	08/22/72	——





REQUIREMENT CHART

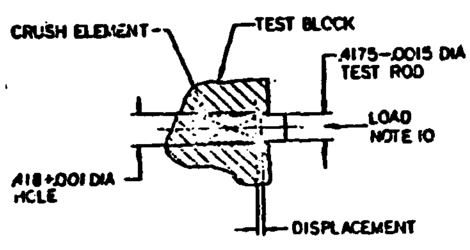


FIGURE I
TEST METHOD

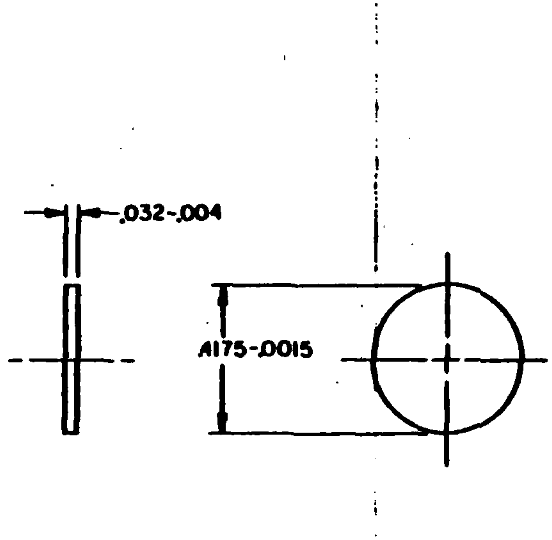
PART NO. 9236518

26 AUG 1972

ELEMENT, CRUSH

D 19203 9236518

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
—	ERR7200346-1 (REL)	08-28-72	—

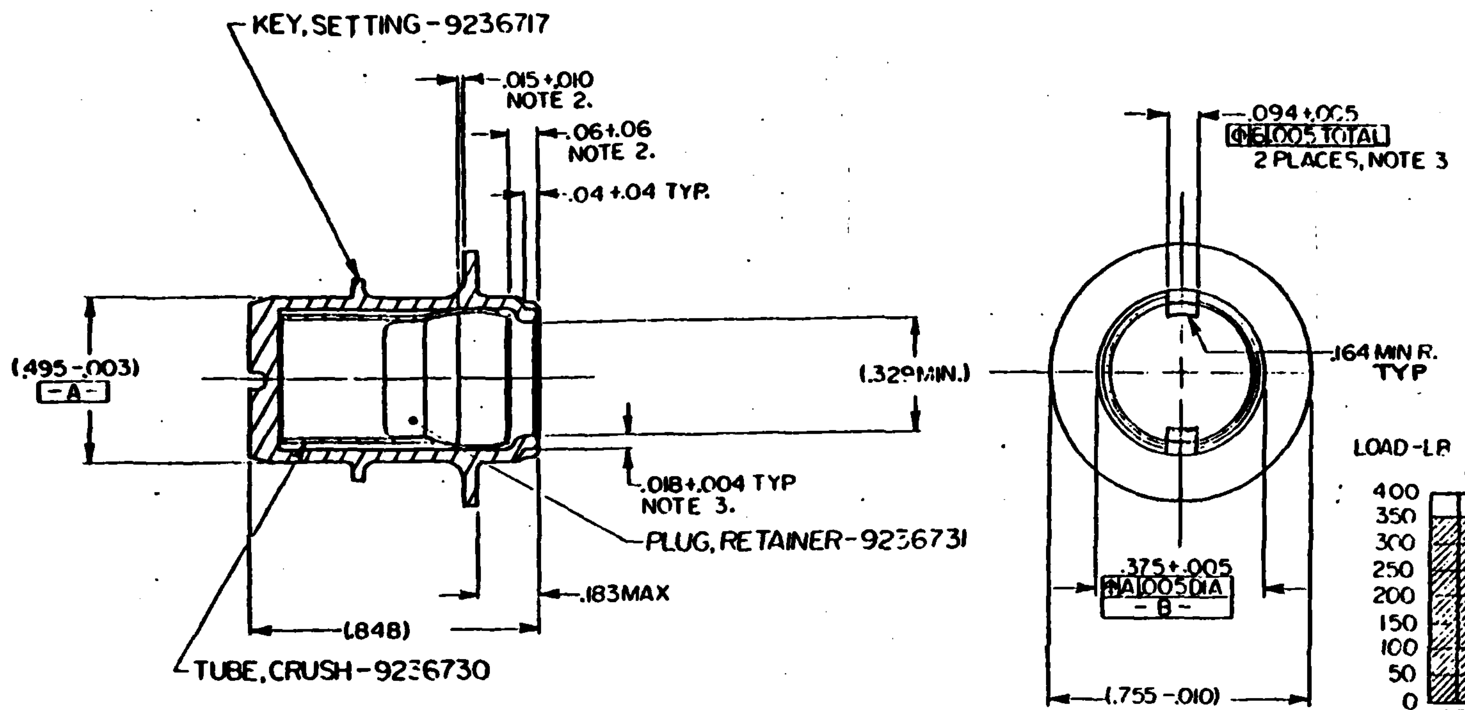


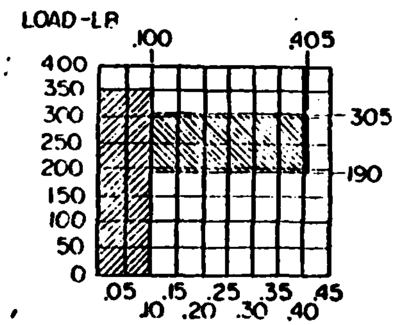
NOTES:-

1- SPEC MIL-A-2550 APPLIES.
2- MATERIAL:- HIGH-STRENGTH STAINLESS AND HEAT-RESISTING CHROMIUM-NICKEL STEEL, SHEET AND STRIP, TYPE 301, FULL HARD, ASTM A177.
3- ALTERNATIVE MATERIAL:- STEEL, CORROSION-RESISTANT (18-8), PLATE, SHEET AND STRIP (ASG), COMPOSITION 301, 302 OR 304 CONDITION FULL HARD, SPEC MIL-S-5059.
4- 125/ ALL OVER, EXCEPT AS NOTED.
5- DRAWDOWN AND/OR DIEBREAK TOTAL .024 MAX. (NOTE 6)
6- 250/ PERMITTED ON DRAWDOWN AND/OR DIEBREAK.

PART NO. 9236519

NEXT ASSY	USED ON	MECHANICAL PROPERTIES		DO NOT SCALE DRAWING	ORIGINAL DATE OF DRAWING		U.S. ARMY MUNITIONS COMMAND
		YP		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	28 AUG 1972		PICATINNY ARSENAL, DOVER, NEW JERSEY 07801
		TS		TOLERANCES ON DECIMALS ±	DRAFTSMAN	CHECKER	RETAINER, CRUSH M
	FUZE, M582	ELG		FRACTIONS ± ANGLES ±	ENGR	ENGR	
9236516	FUZE, M577	RA			ENGR	ENGR	SIZE C / CODE IDENT NO. 19203 / 9236519
APPLICATION		BH					SCALE 4/1 / UNIT WT. / SHEET





DISPLACEMENT-INCHES

REQUIREMENT CHART

SEE NOTE 4.

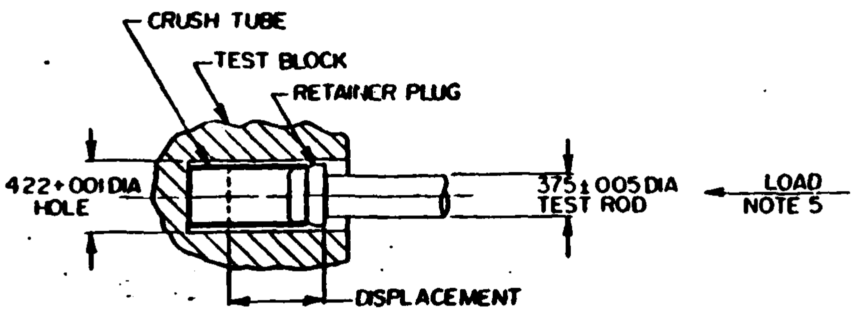


FIGURE 1

TEST METHOD

NOTES:

1. SPEC. MIL-A-2550 APPLIES.
2. INSERT AND COMPRESS CRUSH TUBE WITH RETAINER PLUG IN PLACE TO DIMENSION GIVEN PRIOR TO REDUCING SETTING KEY TO .375±.005
3. FORM TABS AS SHOWN, 2 PLACES.
4. LOAD DISPLACEMENT RELATIONSHIP MUST LIE WITHIN SHADED AREA OF REQUIREMENT CHART WHEN SUBJECTED TO TEST ILLUSTRATED IN FIGURE 1 (NOTE 5)
5. APPLY AXIAL STATIC LOAD AT RATE NOT GREATER THAN .10 INCHES PER MINUTE OF ROD TRAVEL.

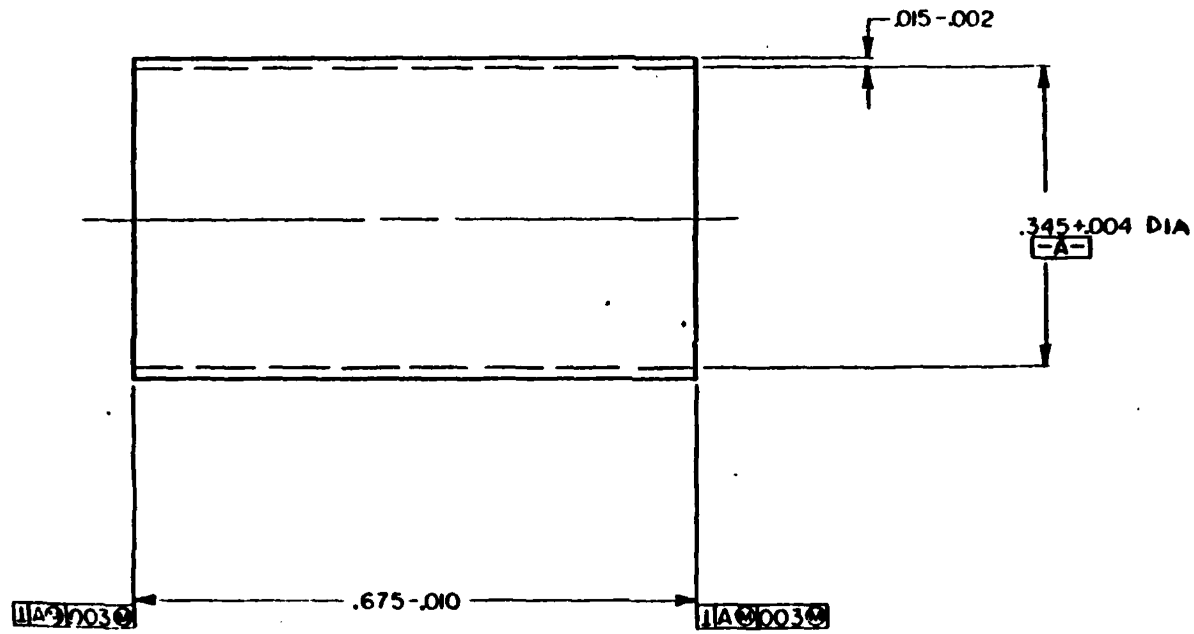
SEE SEPARATE PARTS LIST-9236729

PART NO. 9236729

9236500 / NEXT ASSY	M577 / USED ON	MECHANICAL PROPERTIES	DO NOT SCALE DRAWING. UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON DECIMALS ± FRACTIONS ± ANGLES ±
APPLICATION			

ORIGINAL DATE OF DRAWING	80-06-16
DRAFTSMAN	ds
U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND, DOVER, NEW JERSEY 07801	
TITLE	SETTING KEY ASSEMBLY
SIZE	D
CODE IDENT NO.	19200
DRAWING NO.	9236729
SCALE	4/1

NOTES:
1. SPEC. MIL-A-2550 APPLIES.
2. MATERIAL - SEAMLESS BRASS ALLOY TUBE, ALLOY 260, HARD DRAWN. ASTM B135



PART NO. 9236730

9236729	FUZE M582	
NEXT ASSY	FUZE M577	
	USED ON	
APPLICATION		

MECHANICAL PROPERTIES	
YP	
TS	
EL2	
RA	
BH	
RH	

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ±
FRACTIONS ± ANGLES ±

ORIGINAL DATE OF DRAWING 80-06-16	
DRAFTSMAN ds	CHECKER
ENGR	ENGR
ENGR	ENGR

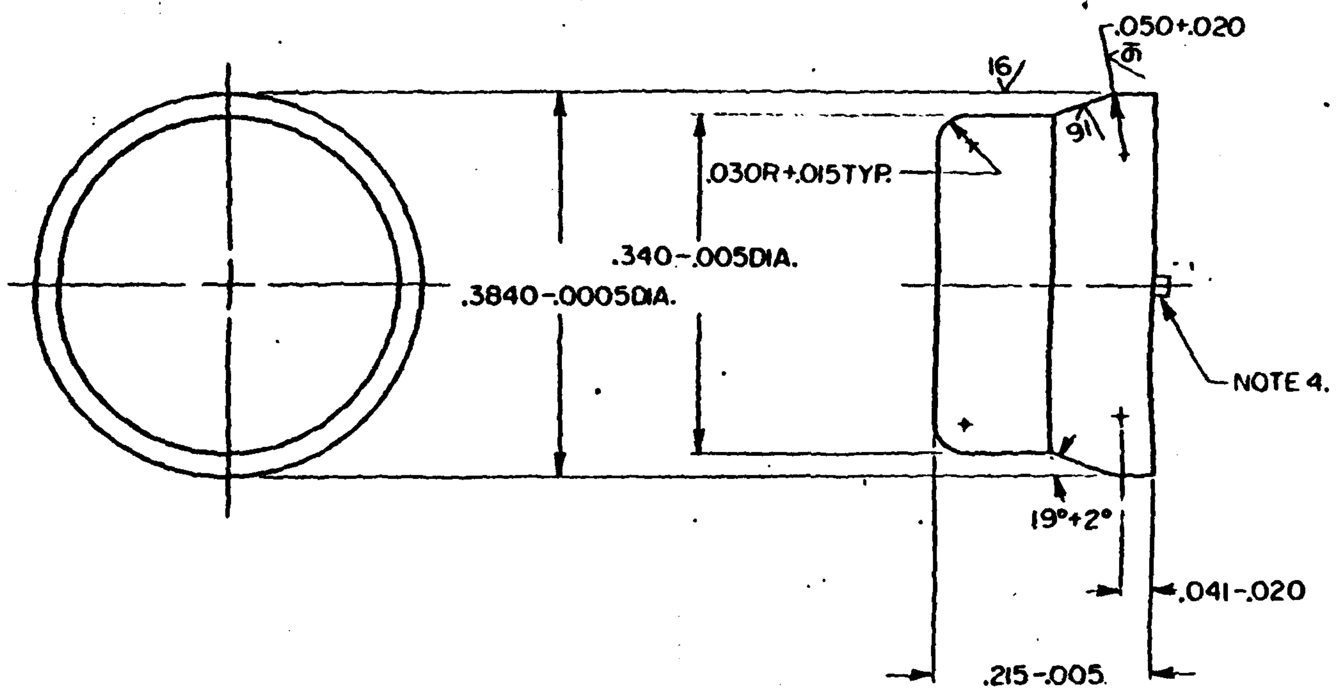
U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801

TUBE, CRUSH

SIZE	CODE IDENT NO	
D	19200	9236730
SCALE 10/1	UNIT WT.	SHEET

NOTES:

1. SPEC. MIL-A-2550 APPLIES.
2. MATERIAL-FREE-MACHINING STAINLESS AND HEAT -RESISTING STEEL WIRE TYPE 416 OR 416Se, COND.T, ASTM A581.
3. 63/ FINISH ALL OVER AS NOTED.
4. CUTOFF BURR PERMISSIBLE .02 DIA.MAX. X .015 LG. MAX.. THIS END ONLY.



PART NO. 9236731

U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801

PLUG, RETAINER

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ±
FRACTIONS ± ANGLES ±

MECHANICAL PROPERTIES: YP, TS, ELS, RA, BH, BH

ORIGINAL DATE OF DRAWING: 80-06-16
DRAFTSMAN: ds
CHECKER
ENGR
ENGR
ENGR
ENGR

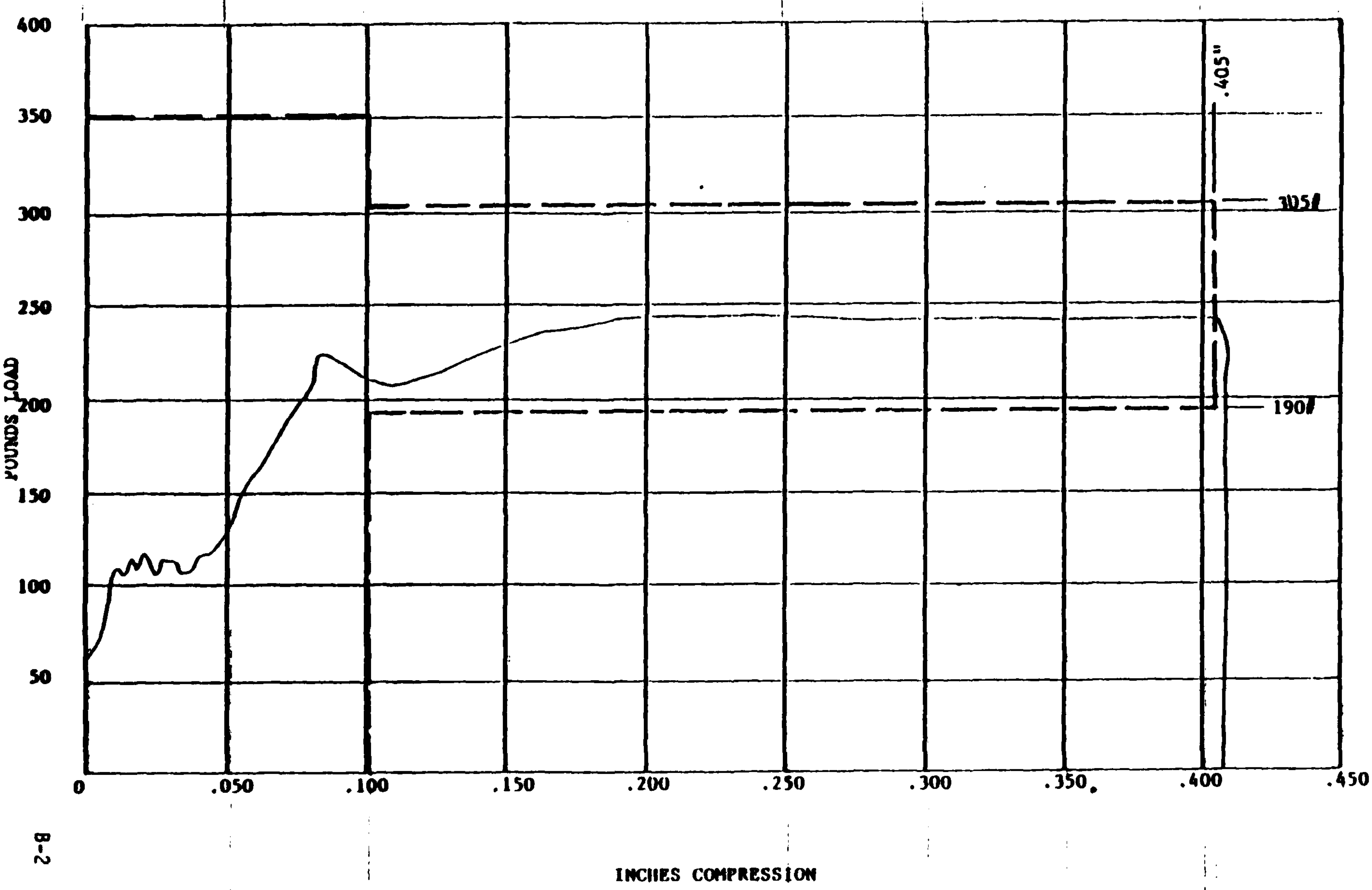
SIZE: D
CODE IDENT NO: 19200
9236731
SCALE: 10/1
UNIT WT.
SHEET

NEXT ASSY	USED ON
	FUZE M557
9236729	FUZE M577

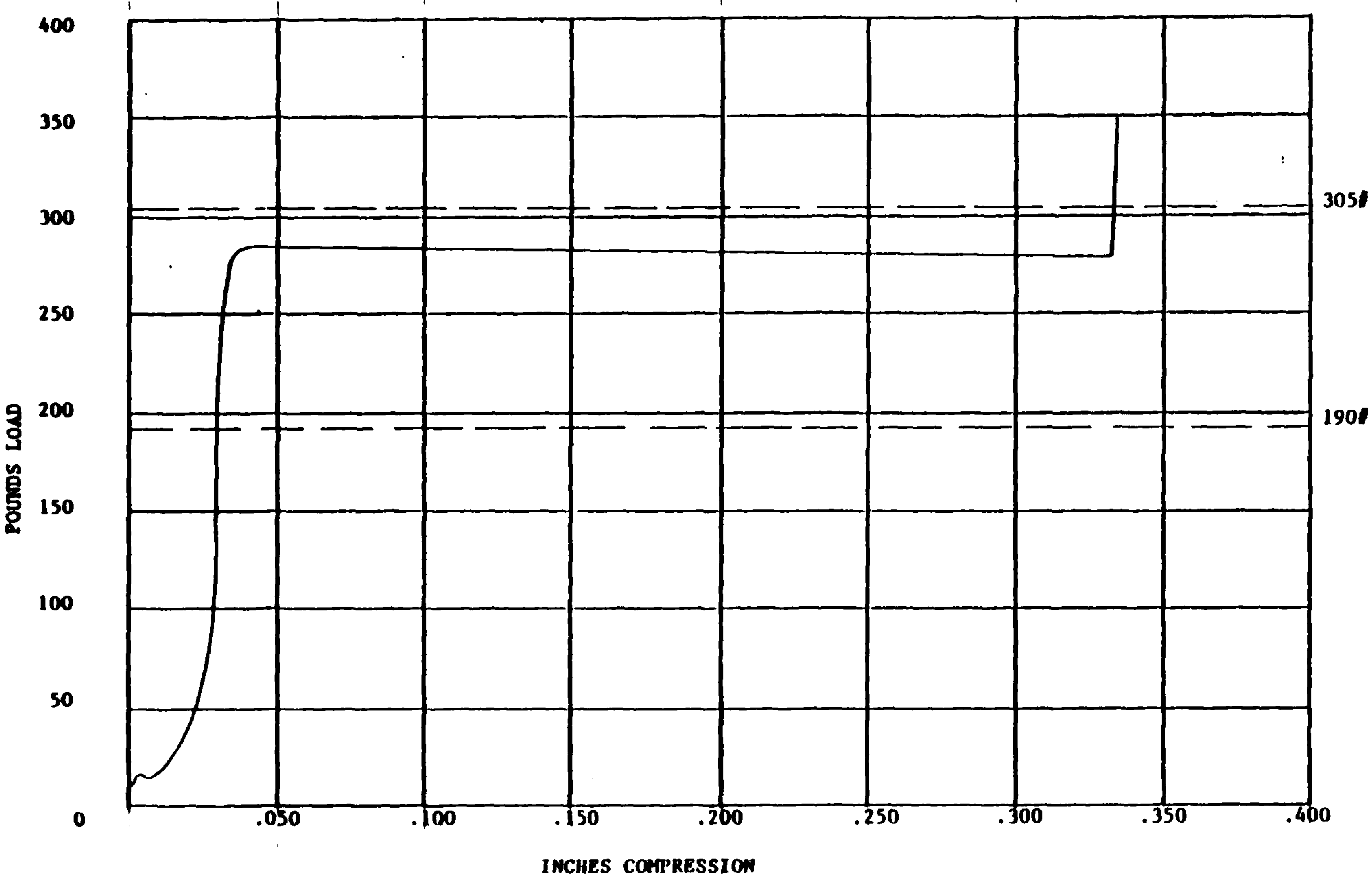
APPLICATION

APPENDIX "B"

COMPRESSION TEST(NOT PRE-CRUSHED)



COMPRESSION TEST (PRE-CRUSHED)



APPENDIX "C"

BALLISTIC AIR GUN TEST DATA

Fuze S/N	Plate Size-In.	Pressure - psi Breech	Muzzle	Accel. G's	Key Ht. - In. Before	After	Key - In. Travel	
NEW DESIGN								
1	.270	9,500	120	26,258	0	+.142	.142	
2	.290	7,800	120	21,499	0	+.124	.124	
3	.300	10,350	120	28,638	-.016	+.138	.154	
4	.310	10,950	80	30,429	-.004	+.154	.158	X
5	.310	11,200	120	31,017	-.001	+.153	.154	(X)
6	.310	10,350	120	28,638	-.004	+.172	.176	(X) Δ
7	.310	10,350	120	28,638	+.002	+.202	.200	(X)
8	.310	10,800	120	29,898	+.004	+.172	.168	(X) Δ
9	.310	10,900	160	30,066	-.004	+.174	.178	(X) Δ
10	.310	10,800	120	29,898	-.007	+.143	.150	X
11	.310	10,950	120	30,318	+.007	+.145	.138	X
12	.310	10,900	120	30,178	-.013	+.179	.192	(X) Δ
PRESENT DESIGN								
13	.310	10,850	100	30,094	+.008	+.136	.128	X Δ
14	.310	11,000	120	30,457	+.002	+.122	.120	
15	.310	10,850	120	30,038	+.003	+.135	.132	X Δ
16	.310	10,500	90	29,142	0	+.144	.144	X Δ

$$G's = \frac{P \times A}{W}$$

A = 19.635 $In.^2$ Area
W = 7.014 lb. Projective Weight
P = (Breech Press.)-(Muzzle Press.)
= psi Effective Pressure

NOTES:

(-) Top of Key Above Ogive

(+) Top of Key Below Ogive

X Firing Plate Deflected

(X) Firing Plate Deflected to Detonator

Δ One side of Firing Plate Deflected more than the other side.

APPENDIX "D"

CALCULATION OF SETBACK FORCES

Weight of Parts:

	gm.	lb.
Setting Key	2.780	.0061279
Crush Element	.335	.0007384
Crush Retainer	.520	.0011462
Crush Tube	1.450	.0031962
Retainer Plug	2.620	.0057752

Setback Force on Crush Retainer:

$$F = W \frac{a}{G} \qquad \frac{a}{G} = 30{,}000$$

$$W = .0061279 + .0007384 = .0068663 \text{ lb.}$$

$$F = .0068663 \times 30000 = 206 \text{ lb.}$$

Setback Force on Retainer Plug:

$$W = .0061279 + .0031962 = .0093241 \text{ lb.}$$

$$F = .0093241 \times 30000 = 280 \text{ lb.}$$

Maximum Acceleration Crush Tube will Stand:

F = 215 lb. (Minimum load to Crush Tube is the Lower Limit of 190 lb. on Crush Tube drawing, plus 25 lb. Friction of Setting Key with Drive Sleeve.)

$$W = .0093241 \text{ lb.}$$

$$\frac{a}{G} = \frac{F}{W} = \frac{215}{.0093241} = 23{,}059 \text{ G's}$$

APPENDIX "E"

BALLISTIC PD TEST DATA

21 JUL 1980

DEPARTMENT OF THE ARMY
U.S. Army Yuma Proving Ground
Yuma, Arizona 85364

FIRING REPORT NO. 14826

Fuze, MTSQ, M577

Manufacturer: Hamilton Technology Inc, Lancaster, PA

Product Improvement Test

Date of Firing: 2 July 1980

Authority: Letter, TECOM, DRSTE-CM-F dated 9 January 1979 and Supplement 27 to TPR LCN-T-2341 dated 25 March 1980

TECOM Project No. 2-MU-007-577-033 lv

1. ITEM UNDER TEST

Fuze, MT, SQ, M577, lot No. HAT80F000E024

2. SUPPORTING MATERIEL AND EQUIPMENT

2.1 AMMUNITION

Projectile, 155-mm, M107, Inert, lot No. LOP-E-116
Propelling Charge, 155-mm, M3A1, lot No. RAD-68860
Pellet, Tetryl, A5, lot No. MA78K000E129
Charge, Spotting, T-2, lot No. LOP-2-20

2.2 WEAPON

Carriage, 155-mm, M1A1, Towed, serial No. 1042
Recoil Mechanism, 155-mm, M6, serial No. 5203
Gun, 155-mm, M1A1, serial No. 7456
Tube, 155-mm, M1A1, serial No. 11157

2.3 EQUIPMENT

Plywood targets
X-ray equipment
Polaroid camera

3. OBJECTIVE

To test a special lot of M577 fuzes that were assembled with a new crush element design.

4. PROCEDURE

Thirty test fuzes were fired in accordance with Supplement No. 27 to TPR LCN-T-2341 (Incl 1). The fuze x-rays were provided to the U.S. Army Armament Research and Development Command (ARRADCOM) representative for evaluation. Polaroid photographs of the fuze setting were made and given to the representative.

5. RESULTS

The 30 test fuzes were assembled to the projectiles and fired against a 2-inch thick plywood target. All rounds functioned on the target. A copy of the preliminary firing data was furnished the contractor's respresentative.

6. OBSERVER

Mr. H. J. Harmer, Hamilton Technology, Inc, Lancaster, PA

SUBMITTED:

Harold G. Eades
HAROLD G. EADES
Project Engineer

REVIEWED:

for Graham Stullenbarger
WILLIAM T. VOMOCIL
Chief, Munitions and Weapons Engineering Branch

APPROVED:

WILLIAM L. SNIDER
Chief, Test Engineering Division

2 Incl
1. TPR-2341, Supplement 27
2. Distribution List

COPY

R 051200Z JUN 80
FM CDRARRADCOM DOVER NJ //DRDAR-LCN-T//
TO RUWJHUA/CDRYPG YUMA AZ //STEYP-MTD//
INFO RUCIAFB/CDRARRCOM ROCK ISL IL //DRSAR-LEW//
BT
UNCLAS
FOR W. VOMOCIL, R. BARTLETT
SUBJ SUPPLEMENT 27 TO TPR-2341

1. REQUEST THE FOLLOWING BALLISTIC TEST TO BE CONDUCTED ON THIRTY (30) EA M577 FUZES OF HAMILTON SPECIAL ENGINEERING LOT HAT-80F000E024. THE ABOVE LOT TO BE FIRED AS FOLLOWS:
   155MM, M1, 21, PLUS 70 DEGREES, PD FUNCTION, 30 EA
2. THE FOLLOWING DATA WILL BE RECORDED FOR ALL ROUNDS:
   A. POLAROID PHOTO (FUZE SETTINGS)
   B. PEAK CHAMBER PRESSURES
   C. X-RAY ALL FUZES
3. HAMILTON PERSONNEL WILL WITNESS TEST.
4. FUNDS AVAILABLE UNDER SUBJECT TPR.
5. THIS SPECIAL FUZE LOT ASSEMBLED WITH A NEW CRUSH ELEMENT DESIGN.
6. PER AR-200-1 THE EIA ACTION IS NOT MAJOR. A SIGNIFICANT ENVIRONMENTAL IMPACT WILL NOT RESULT FROM THE ACTION AND THE IMPLEMENTATION OF THE PLAN OR ACTION WILL NOT BE ENVIRONMENTALLY CONTROVERSIAL.

BT
67262

Incl 1

Sup # 27

Fuze, MT, SQ, M577
Lot No. HAT80F-000E024

3004-3234-91

July 80 Clearance No. 25

820 ft -5
TARGET Function

	Tube Rd No	Time Fired	Sample No	Elev	PSI x100		Funct	Miss Target
1	4831	1340	S	34.0			-	NA
2	4832		S	32.0		Right To Left	-	NA
3	4833		S	30.6	NA		-	NA
4	4834		Test 50	31.0	R#1		OK	
5	35		51	31.0			OK	
6	36		52	31.0			OK	
7	37		53	30.8			OK	
8	38		54	30.8			OK	
9	39		55	30.6			OK	
10	40		56	30.6			OK	
11	41		57	30.6			OK	
12	42		58	30.6			OK	
13	43		59	30.6			OK	
14	44		60	30.4			OK	
15	45		61	30.2			OK	
16	46		62	30.2			OK	
17	47		63	30.2			OK	
18	48		64	30.2		Left To Right	OK	
19	49		65	30.2			OK	
20	50		66	30.0	R#2		OK	
21	51		67	30.0			OK	
22	52		68	30.0			OK	
23	53		69	30.0			OK	
24	54		70	30.0			OK	
25	55		71	30.0			OK	
26	56		72	30.0			OK	
27	57		73	30.0			OK	
28	58		74	30.0			OK	
29	59		75	29.8			OK	
30	60		76	29.8			OK	
31	61		77	29.8			OK	
32	62		78	29.8			OK	
33	4863	1805	79	29.9			OK	

30 for 30

PRELIMINARY INFORMATION SUBJECT TO CONFIRMATION BY FINAL REPORT

Scribe (fuzes.

Proj. lot No. LOP-E-116

Prop Lot No.. M3A1 – RAD-68860

T2 – LOP-2-20 } 10 EA
IOP-5-2 } 20 EA

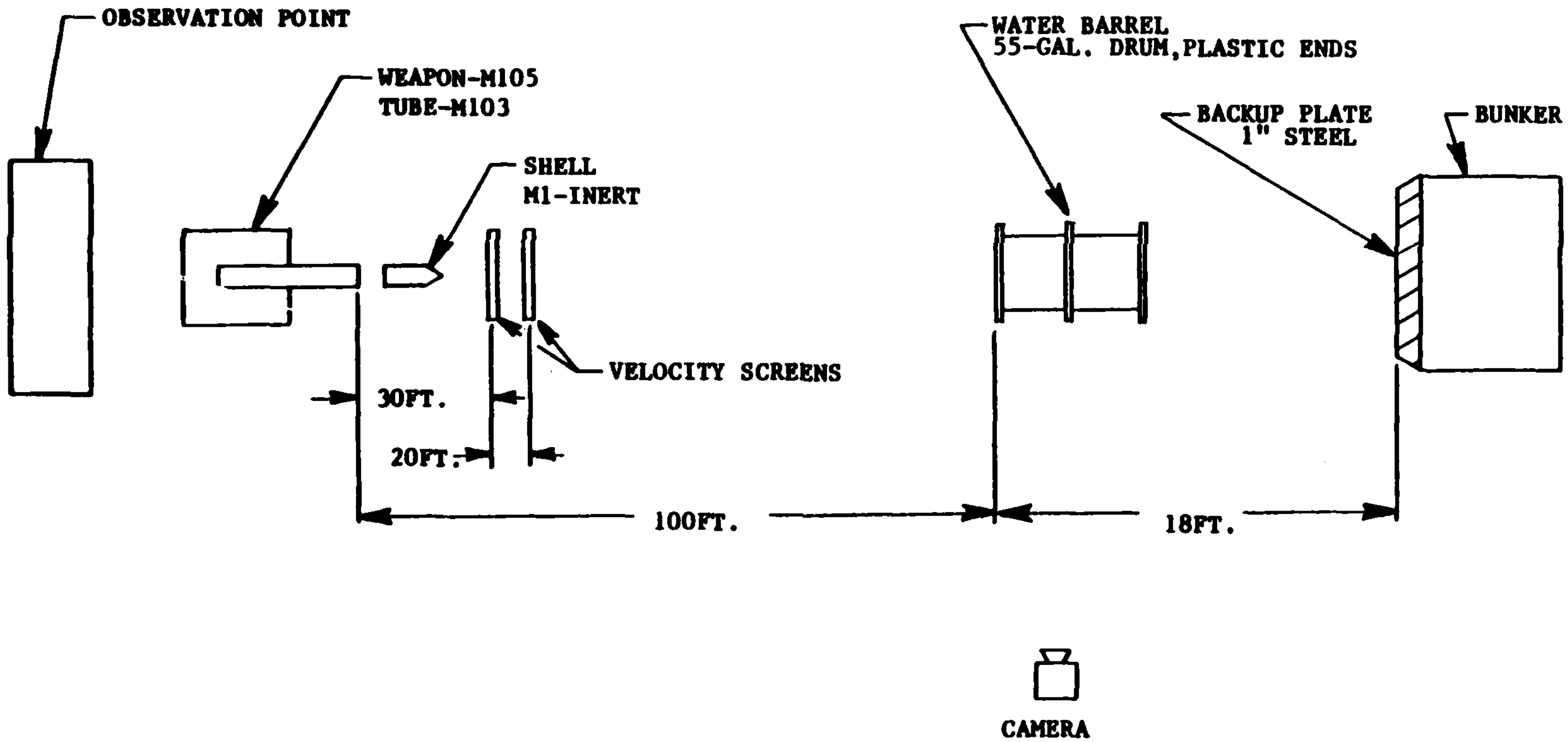
AS Tetryl – MA78K 000 E 129

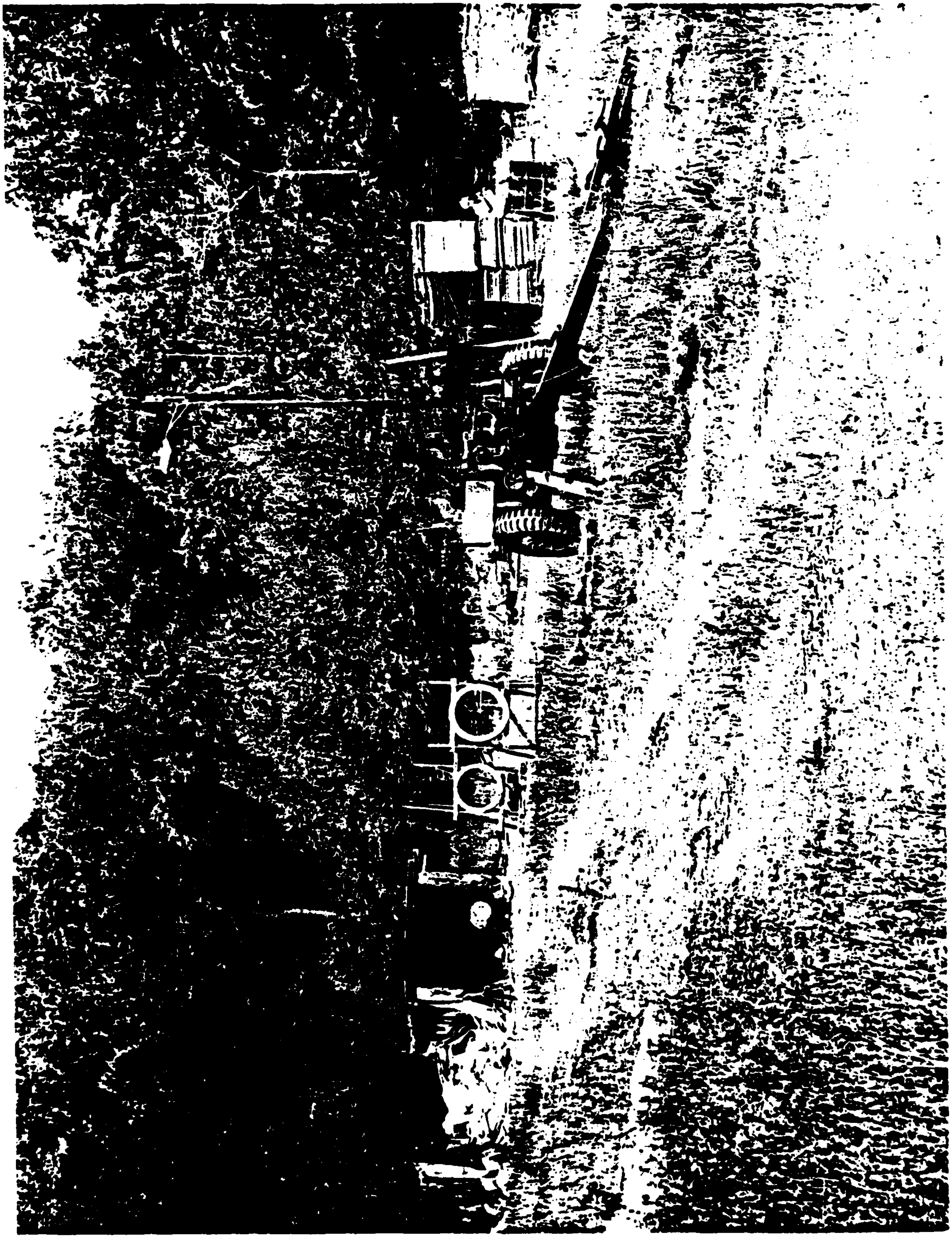
Primers MK2A4 Perc – LS-186-15

APPENDIX "F"

BALLISTIC WATER IMPACT TEST DATA

BALLISTIC WATER IMPACT TEST SETUP





PURPOSE OF TEST

Fuze Lot No.

M577 FUZE WATER IMPACT TEST

HAT 80 F 000 E 024

SHEET 1 OF 2

GUN OR HOW.		TUBE OR LINER	CARRIAGE	RECOIL SYSTEM	GUN POSITION	SOLENOID COIL DISTANCE	DATE July 22 1980	OBSERVERS
Cal.	105 MM	105 MM	105 MM	105 MM	LOCATION 647	GUN TO FIRST 30 FT	PROJ. NO.	
NO.		56089	8233	4330	WEATHER CLEAR	DISTANCE 1st AND 2nd 20 FT		Mr PERKINS
MODEL	M2A2		M2A2	M2	TEMP. OF POWDER 70°F	OUTSIDE DOT.		PROOF OFFICER
MFG.			PULLMAN STD	ROCK ISLAND		INSIDE DOT. / AVERAGE		"JOE" KOSUR

Round No.	Type of Firing	Powder Weight oz	Projectile Weight lbs	oz	Fuze	Muzzle Velocity f/s		Gauge No.	Press.	Press.	Remarks
											BOOSTER 1 OZ FLAKE
A 1	[illegible]	6	32	8	INERT	[illegible]	[illegible]		8.4	[illegible]	CHECK RD [illegible]
R 2	[illegible]	5.5			INERT	[illegible]	[illegible]		No Gauges		" " [illegible]
1	[illegible]	5.8			M577	[illegible]	[illegible]		7.7	7.2	No. 43 FUZE [illegible]
2	[illegible]	5.8			" "	[illegible]	[illegible]		7.0	—	No. 17 FUZE " [illegible] 2
3	[illegible]	5.7			" "	[illegible]	[illegible]		6.0	6.1	No. 18 FUZE " " TEST " 3
4	[illegible]	5.8			" "	[illegible]	[illegible]		5.6	—	No. 19 FUZE " " " TEST " 4
5	[illegible]	5.7			" "	[illegible]	[illegible]		5.5	5.6	No. 20 FUZE " " " TEST " 5
					23 JULY 1980						
6	[illegible]	6.1			M577	[illegible]	[illegible]	T-18	7.8	7.9	No. 43 Fuze No Function
7	[illegible]	6.1			"	[illegible]	[illegible]		7.9	7.9	No. 21 Fuze FUNCTION
8	[illegible]	6.1			"	[illegible]	[illegible]		8.1	8.1	No. 22 Fuze FUNCTION
9	[illegible]	6.1			"	3937	[illegible]		8.1	8.1	No. 23 Fuze FUNCTION
10	[illegible]	6.1			"	[illegible]	[illegible]		7.6	7.7	No. 24 Fuze FUNCTION
11	[illegible]	6.1			"	[illegible]	[illegible]		8.3	8.2	No. 25 Fuze FUNCTION
12	[illegible]	6.1			"	[illegible]	[illegible]		7.7	7.6	No. 26 Fuze FUNCTION
13	[illegible]	6.1			"	[illegible]	[illegible]		7.5	7.4	No. 27 Fuze FUNCTION Booster Cup Recovered ½
14	[illegible]	6.1			"	[illegible]	[illegible]		7.7	7.7	No. 28 Fuze FUNCTION
15	[illegible]	6.1			"	[illegible]	[illegible]		7.9	7.9	No. 29 Fuze FUNCTION Booster Cup ½ oz
16	[illegible]	6.1			"	[illegible]	[illegible]		7.8	7.9	No. 30 Fuze FUNCTION
17	[illegible]	6.1			"	[illegible]	[illegible]		7.5		No. 31 Fuze FUNCTION
18	[illegible]	6.1			"	[illegible]	[illegible]		7.5	7.6	No. 32 Fuze FUNCTION
19	[illegible]	6.1			"	[illegible]	[illegible]		7.8	7.9	No. 33 Fuze FUNCTION
20	[illegible]	6.1			"	[illegible]	[illegible]		7.5	7.4	No. 34 Fuze FUNCTION
21	[illegible]	6.1			"	[illegible]	[illegible]		7.4	7.3	No. 35 Fuze FUNCTION

BALLISTIC DATA SET

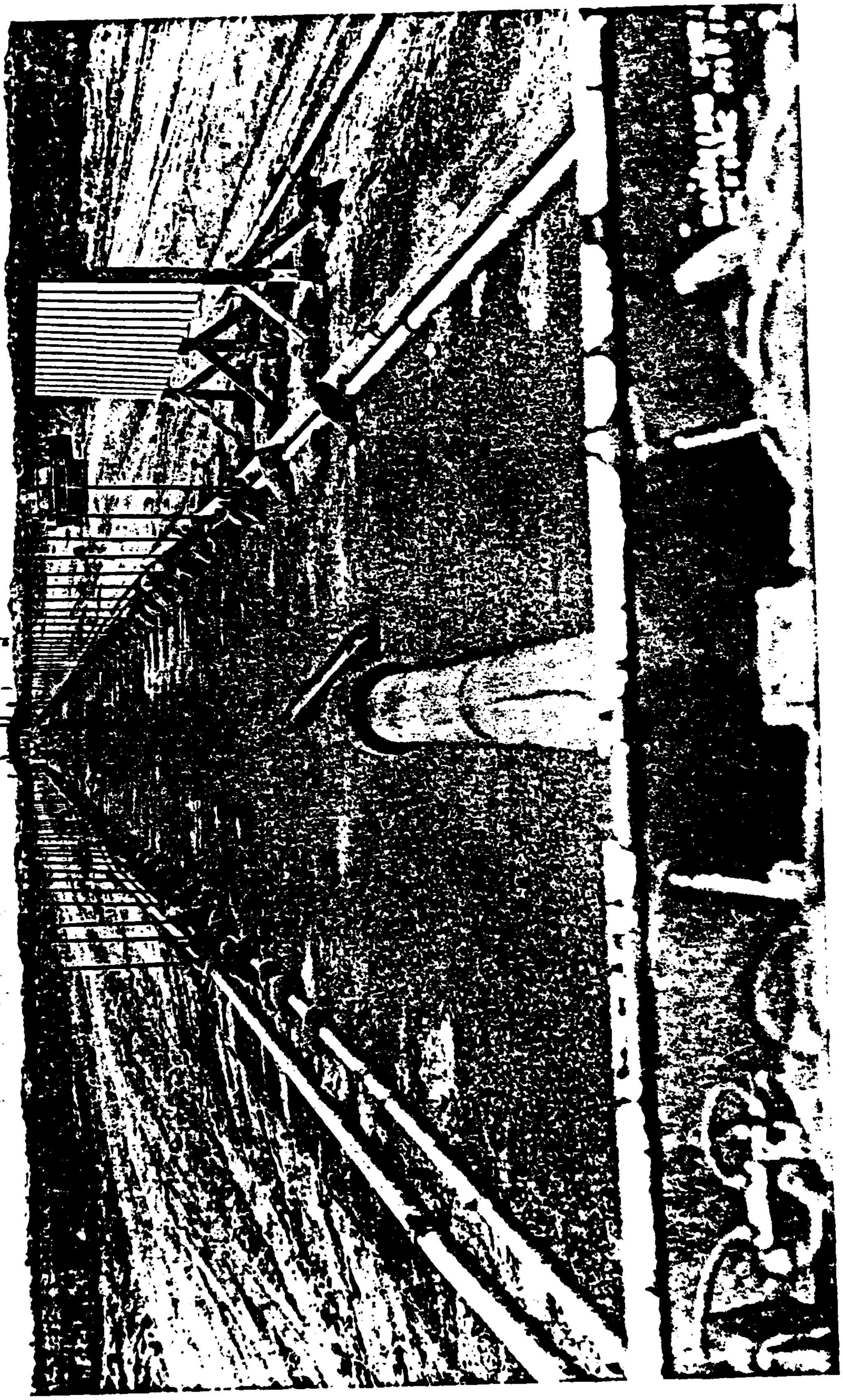
PURPOSE OF TEST	M577 FUZE WATER IMPACT TEST	FUZE LOT No. HAT 80F 000 E 024	SHEET 2 OF 2

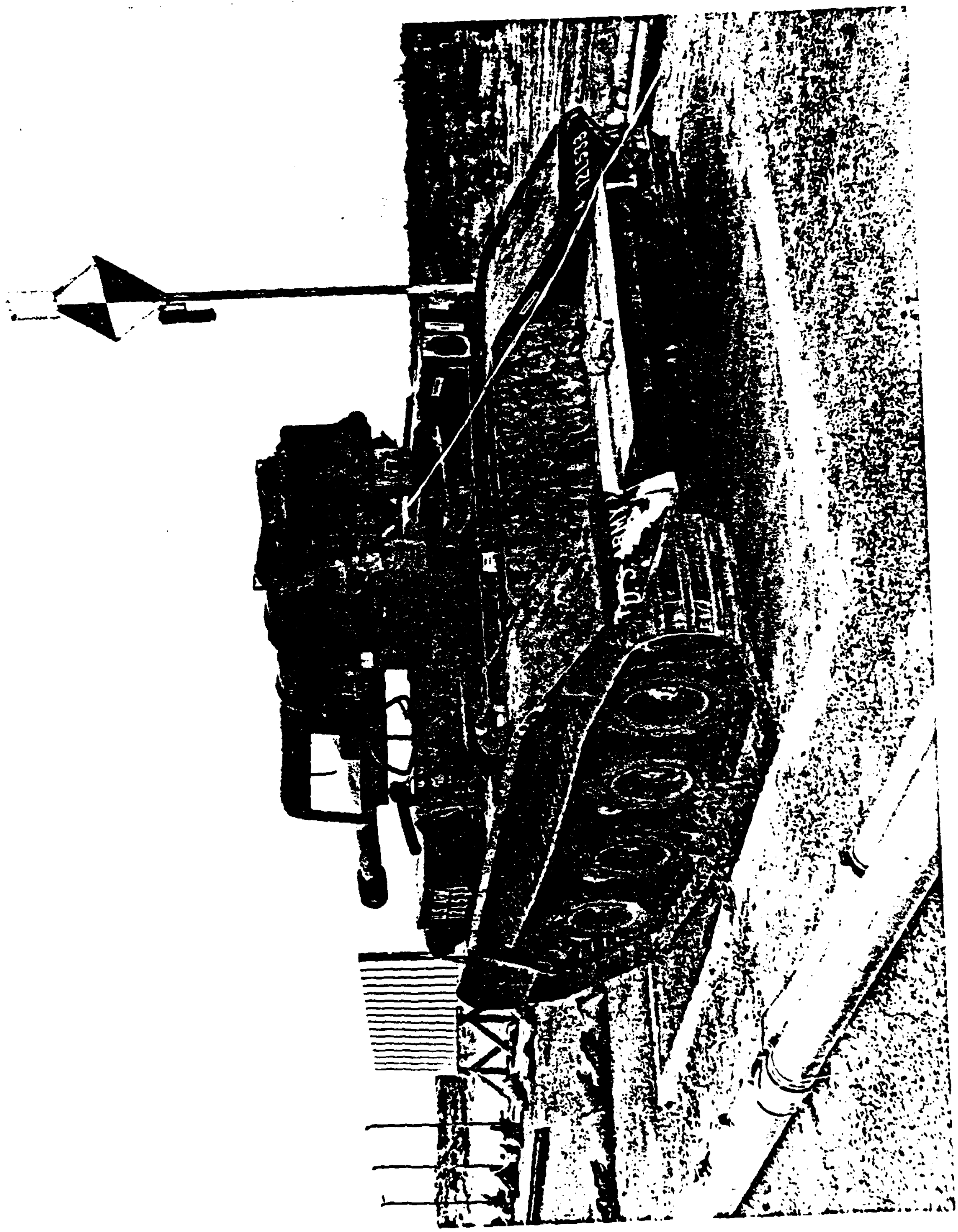
	GUN OR HOW.	TUBE OR LINER	CARRIAGE	RECOIL SYSTEM	GUN No.	SOLENOID COIL DISTANCE	DATE 23 July	OBSERVERS
CAL.	105 MM	105 MM	105MM	105 MM	LOCATION 647	GUN TO FIRST	PROJ NO.	PERKINS
NO.		56059	8233	4330	WEATHER CLR	BETWEEN 1ST AND 2ND	DATA BOOK NO.	PROOF OFFICER
MODEL	M2A2		M2A2	M2	TEMP. OF POW 70°F	OUTSIDE TOP	EXP. ORDER	
MFG.			Pullman Std	Rock Island		INSIDE TOP / OUTSIDE BOT / INSIDE BOT / AVERAGE		

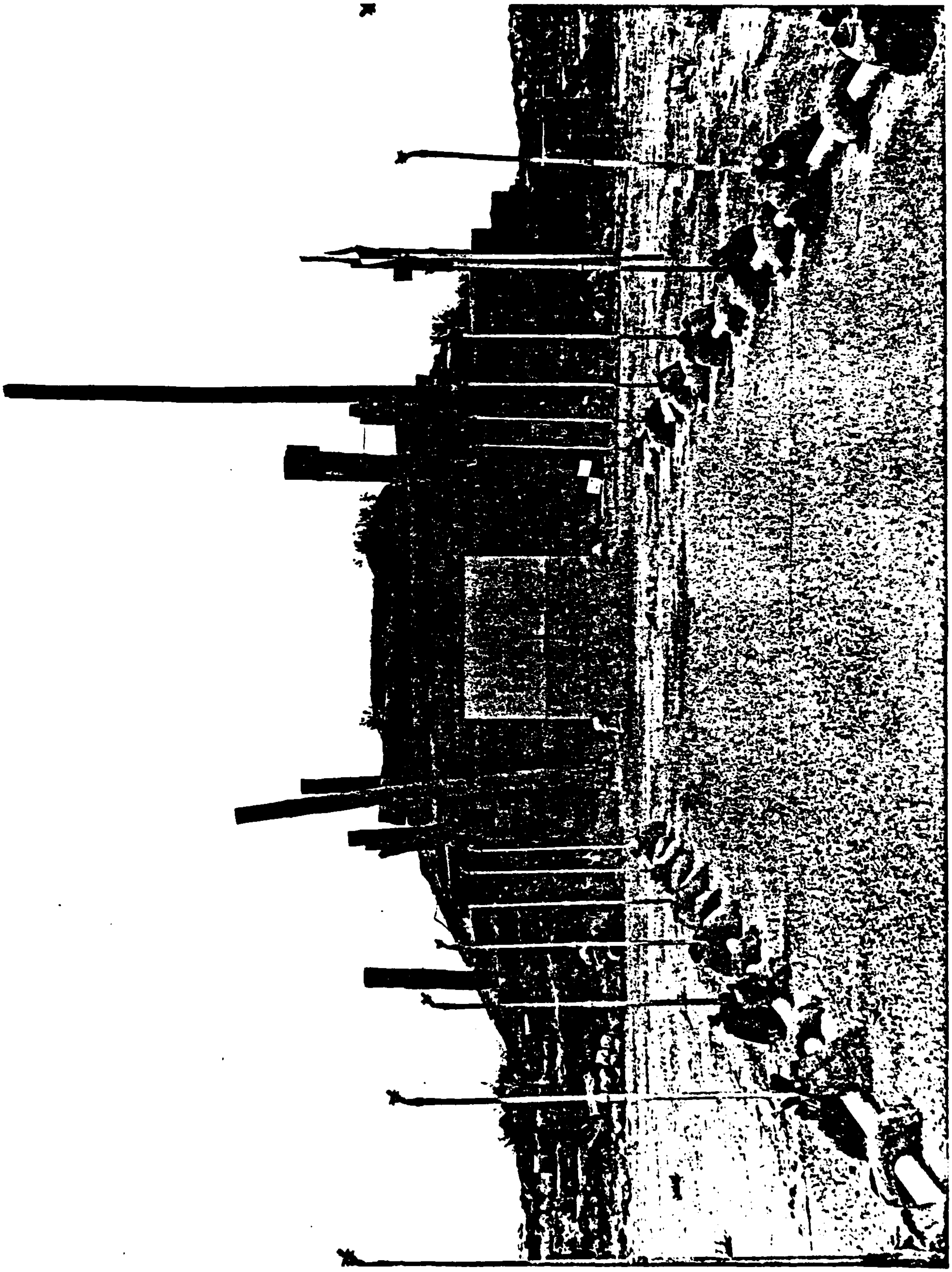
Round No. Test	Tube or Liner	Time of Firing	Powder Band and Lot	Powder Weight	Projectile Band and Lot	Projectile Weight		Case or Seating	Primer	Booster	Fuze Kind and Lot	Fuze Setting	Fuze Action	Elevation	Shell Functioning	Muzzle Velocity Obs.	Muzzle Velocity Count	Muzzle Flash Size	Muzzle Flash Color	Muzzle Smoke Amt	Muzzle Smoke Color	Pressure Gauge No.	Pressure Gauge No.	Press.	Av.	Recoil	
22		1029		6.1		32	8				M577					[illegible]	521.1					T18	7	7.4			FUZE No 36 FUNCTION
23		1019		"		"			[illegible]			"				[illegible]	516.4						8	7.9			FUZE No 37 FUNCTION
24		1029		"		"						"				[illegible]	505.8						7	7.4			FUZE No 38 FUNCTION
25		1032		"		"			[illegible]			"				[illegible]	5[illegible]						7	7.8			FUZE No 39 FUNCTION
26		10.K		"		"			[illegible]			"				[illegible]	517.3						7	7.7			FUZE No 40 FUNCTION
27		1025		"		"						"				[illegible]	519.9						7	7.6			FUZE No 41 FUNCTION

APPENDIX "G"

BALLISTIC RAINFIELD
TEST DATA







TEST TRACK DIVISION
OPERATIONS PLAN

OPLAN No: 63R-A JON: 921CSY45 DATE: 18 July 1980

TITLE: M577 MTSQ Fuze Tests

CUSTOMER: ARRADCOM SECURITY CLASSIFICATION: Unclassified

AUTHORITY: Test Directive dated 16 Jun 80

OBJECTIVE: To evaluate the performance of the M577 MTSQ Fuze in a simulated heavy rain environment.

DESCRIPTION: The test will be conducted on the Haydraw Ballistic Rainfield. A maximum of 100 90mm rounds will be fired from a M56 self-propelled 90mm gun. The rainfield will provide a simulated rain rate of 20 to 35 inches-per-hour over a length of 1200 feet. Approximately 50 M577 fuzes (test) and 20 M557 fuzes (control) will be tested. One control fuze (M557) will be fired before and after each group of five test fuzes (M577). Muzzle - 2700 FPS velocity will be measured on five rounds using photo-optical techniques. The gun muzzle will be located approximately 50 feet from rainfield entrance. Two burster screens will be located at equal distances between rainfield exit and the bunker. Each burster screen will be eight ft by eight ft plywood, the first one 1/2 inch thick and the second two inches thick. Volumetric rain rate data will be collected pre and post-test. Wind velocity data will be monitored by three anemometers located along the length of the rainfield. [illegible] The maximum allowable crosswind will be three knots. All projectiles will be inert. However, the M577 fuze will contain a booster charge which will result in fuze fragmentation upon functioning. The M557 fuze will contain a spotting charge. The control fuze (M557) is expected to function in the rain. Fuze performance will be monitored by K-38 IR cameras and visual observation. The IR cameras and observers will be located 1000 ft south of the range.

LAUNCH POINT: Ballistic Range

HAZARD AREAS: North/South Boundary: 1000 feet either side of the Ballistic Rainfield
East/West Boundary: West Track Road to 10,000 feet west of bunker

NOTE: All personnel will be required to be behind protective blocks for each round fired. Unmanned vehicles will be considered safe 150 feet behind the gun. No personnel will be allowed within the hazard area except those required to conduct the test within the vicinity of the gun (behind the gun during firings).

AREA CLEARANCES: Initial: T-1 hr Final: T-10 mins

EOD: As Required

TEST SUPPORT:

1. TKI: Provide anemometers and Tipping Bucket rain gauge support as required by WE.

2. TKS:

a. Set up and operate the Ballistic Rainfield.

b. Position bunkers and assist with gun positioning as required.

c. Provide portable light carts and generators as required.

d. Fabricate velocity measurement target board and burster screens as required. Replace or repair burster screens as required.

TEST MANAGER: Mr D. M. Severson, ext 2162 *DMS*

CUSTOMER REP: Mr E. M. Ivankoe, ARRADCOM/DRDAR-TSE-IL, AV 880-3355

J C Key, Jr.

J. C. KEY, Jr., Major, USAF
Acting Chief, Operations Branch

2 Atch
1. Annex "A"
2. Countdown

ANNEX "A" TO OPLAN 63R

DATE July 30, 1980

I. INSTRUMENTATION ENGINEER: R.L. Saenz

II. DATA MANAGER: ____

III. LAUNCH FACILITY: NONE TRACK STATION: Ballistic Range

RAILS TO BE USED: ~~1 2 3~~ NOT USED

IV. INSTRUMENTATION SUPPORT:

T - TRACK C - CUSTOMER N/R - NOT REQUIRED

1. TRANSDUCERS: N/R
2. SIGNAL CONDITIONING: N/R
3. TELEMETRY: N/R
4. ON-BOARD RECORD: N/R
5. VELOCITY MEASUREMENT:
   - A. SLEDBORNE OPTICAL: N/R
   - B. SLEDBORNE MAGNETIC: NR
   - C. TRACKSIDE MAGNETIC: NR

     FROM T.S. ____ TO T.S. ____
   - D. SPECIAL: NR

     DESCRIPTION: ____
6. SLEDBORNE INSTRUMENTATION CONTROL: NR
   - A. SIDE PULL UMBILICAL: ____
   - B. FIRST MOTION UMBILICAL: ____
   - C. COMMAND SYSTEM: ____
7. UMBILICAL RETRACTOR: NR

   LARGE: ____

   SMALL: ____
8. SPECIAL MARKERS OR SWITCHES: NR

   MAGNETIC SENSORS: ____

   LOCATIONS: T.S. ____

   BREAKWIRES: ____

   LOCATIONS: T.S. ____

   BREAKSTICKS: ____

   LOCATIONS: T.S. ____
9. SPECIAL TIMING & EVENT PROGRAMMING: N/R

   (SEE CHART #1 IF REQUIRED)

10. TELEMETRY TAPE RECORDING: NR

(SEE CHART #2 IF REQUIRED)

11. TELEMETRY DATA: NR

(SEE CHART #3 IF REQUIRED)

12. QUICK LOOK OSCILLOGRAPHS: NR

(SEE CHART #4 IF REQUIRED)

13. COMMUNICATIONS: NR

A. BLOCKHOUSE:

1) STANDARD:

2) SPECIAL: (DESCRIPTION)

B. MOBILE LAUNCH:

1) STANDARD:

2) SPECIAL: (DESCRIPTION)

C. TRACKSIDE:

1) (DESCRIPTION)

D. TELEMETRY VAN:

1) (DESCRIPTION)

14. SPECIAL SCREENBOXES: NR

A. LOCATIONS: T.S.

15. METEOROLOGICAL MEASUREMENTS: T

A. FIXED ANEMOMETERS: NR

LOCATIONS: T.S.

B. PORTABLE ANEMOMETERS: T

LOCATIONS: T.S. Ballistic Range (See Meteorological Personnel for specific locations)

C. TEMPERATURE: C

LOCATIONS: T.S.

D. BAROMETRIC PRESSURE: C

LOCATIONS: T.S.

E. HUMIDITY: C

LOCATIONS: T.S.

SUPPLEMENT TO ANNEX C

OPLAN NO.: 63R

JON: 921CSY45

DATE PREPARED: 30 July 80

RAINFIELD DATA

RAINFIELD LENGTH 1200 feet T.S. Ballistic TO T.S. 15ft Separation

RAINFIELD CONTROL STATIONS N/A

VOLUMETRIC RAIN RATE 20 min to 36 in/hr .25 in/hr avg centerline

EQUIVALENT NATURAL RAIN RATE N/A

WIND RESTRICTIONS: DWNTRK - 5K CRSTRK 3K

MANIFOLD:	INSIDE	OUTSIDE
NOZZLE TYPE	H 1/2 U80200	N/A
NOZZLE ANGLE	50^{0}	N/A
NOZZLE PRESSURE	3 PSIG	N/A
MANIFOLD PRESSURE	6 PSIG	N/A
RISER HEIGHT	7 ft	N/A

COMMENTS: 2.75 - 3.15 min mean diameter drop size.

Test Track Division
18 July 1980

MASTER COUNTDOWN

OPLAN 63R-A

F - FISHER Q - QUAILWALK H - HARMONY S - SAFETY T - TOBOGGAN

CALL SIGN	FUNCTION
F-40	Timer/Programmer
F-42/43	Trackside Instrumentation
F-44/45	Sled Instrumentation
F-46	TDC TM
F-47	TM Mobile Van/Arc Building TM
F-50	TV Camera
F-57	Instrumentation Engineer/Sled Instrumentation Chief
H-35	Launch Supervisor
H-36	Track Support Supervisor
H-37/38	Heavy Equipment Operator
T-39	Senior Controller
T-41/42	Test Manager
T-43/44	Sled Launch Crew Chief
T-45	Alignment Supervisor
T-72	Rainfield Operator
T-73	TKE Engineer
T-74	Customer
S-1	Mobile Safety
S-2	Mobile Safety
S-3	Helicopter Safety
S-4	Launch Pad Safety
Q-31	Laser Camera Operator
Q-34	Photo-Optical Supervisor
TC	Track Control

NOTE: T-41/42 Requires action by either call sign
T-44, T-42 Requires action by both call signs
*Radio Call Not Required

D. M. Severson
D. M. SEVERSON
Test Manager/TKO

L-1 DAY COUNTDOWN

Time		Item	Agency	
0800	1.	Rainfield ready.	T-72	____
	2.	Pillboxes, light carts positioned.	H-36, H-37	____
	3.	Gun positioned and leveled.	H-37, T-45	____
1600	4.	Targets positioned.	T-41	____

L-DAY GUN SIGHTING AND MUZZLE VELOCITY MEASUREMENT COUNTDOWN

Time T- Hr	Min	Sec		Item	Agency	
01	00	00	1.	Initial area clearance.	S-1, S-2	____
	45	00	2.	Weapon ready; ammunition available.	T-74	____
			3.	Generators operational and full of fuel.	Q-34, H-36	____
	20	00	4.	Camera loaded and ready.	Q-34	____
			5.	Begin announcing T-time.	TC	____
	10	00	6.	Final area clearance.	S-1, S-2	____
			7.	Announce count.	TC	____
	05	00	8.	Announce count.	TC	____
	02	00	9.	Verify hazard area clear.	S-1, S-2	____
			10.	T-41 cleared to load gun.	TC	____
		60	11.	Announce count.	TC	____
			12.	Gun loaded.	T-41	____
		05	13.	Initiation 05 second count to fire.	T-41	____
00	00	00	14.	Fire.	T-74	____
			15.	Record fire time and round number.	TC	____
			16.	Verify gun safe.	T-41	____
			17.	Reload camera.	Q-34	____
			18.	Repeat Steps 12 through 17, as required, to complete gun sightings and/or velocity measurements.	T-41, TKOC	____

Countdown 63R-A

L-DAY RAIN TEST COUNTDOWN

Time T- Hr	Min	Sec		Item	Agency	
	10	00	1.	Volumetric rainfield calibrations complete.	T-72	____
			2.	Rainfield ready.	T-72	____
			3.	Verify final area clearance.	S-1, S-2	____
	05	00	4.	Announce count.	TC	____
			5.	Verify clocks synchronized.	TC, Q-34	____
	02	00	6.	Rainfield "UP" and "GO".	T-72	____
			7.	Verify hazard area clear.	S-1, S-2	____
			8.	T-41 cleared to load gun.	TC	____
		60	9.	Announce count.	TC	____
			10.	Gun loaded.	T-41	____
		30	11.	Wind velocity "GO".	T-41	____
		05	12.	Initiate 05 second countdown to fire.	T-41	____
00	00	00	13.	Fire.	T-74	____
			14.	Record round number and fire time.	TC	____
			15.	Verify gun safe.	T-41	____
			16.	Verify fuze functioned and give location (Target or Rainfield).	T-74	____
			17.	Repeat Steps 6 through 16, as required, to complete testing.	TC	____
			18.	In the event a fuze fails to function, notify Track Control and determine if EOD is required.	T-41	____

NOTE: Targets will be repaired/replaced as required after Item #16.

FIRING LOG TO BE MAINTAINED BY TRACK CONTROL

Round Number	Fire Time	Fuze Functioned In Rain	Fuze Functioned On Target

NOTE:

Under round number for gun sighting rounds put in "SIGHT-IN"; for test rounds, number each one sequentially beginning with Number 1.

DYNALECTRON CORPORATION
land-air division

TOP № O-7-7

HIGH SPEED TRACK
OPTICAL PLAN

Oplan Series: 63R-A	Letter of request for T.O.P.: M.E. BUSH	Date Info. rec'd: 30 JULY '80	Date T.O.P. Due: 7 AUG. '80
Project Title: M-577 MTSQ FUZE TEST	Prepared By: BAGWELL	Date Completed: 31 JULY '80	Date of scheduled run: 12 AUG. '80
J.O.N.: 921CSY45 — L/A No.: 0205	Checked By: T. L. Gilmore		Date: 7-31-80
Test Manager: MR. D. SEVERSON	Approved By: Billy D. Adams		Date: 8-1-80

Station	T.S. Location	Camera Type	Lens Size	FPS	Film Type	Film Length	Program On	Program Off	Coverage Segment Horiz	Coverage Segment Vert	Image Size Horiz	Image Size Vert	Assignment
F-2814	DS 1250	K-38	24	One Frame	2424	125'	MANUAL		810'	405'	.022	.022	F-2814 (DS 1250) VIEW
	1080' South		INCH	Per Round	IR				⊥	⊥	IN/FT	IN/FT	FROM SEGMENT DS 750
													THRU SEGMENT DS 1550
													(CAMERA WILL BE
													ANGLED TO THE EAST
													SLIGHTLY SO THAT
													THE GUN LOCATION
													WILL BE IN THE
													RIGHT SIDE OF THE
													FORMAT AND STILL
													HAVE OVERLAPPING
													COVERAGE WITH CAMERA
													COVERAGE FROM F-2815)
													WILL BE USED TO VIEW
													THE GUN AT FIRE AND
													FUZES THRU RAINFIELD
													TO EVALUATE SENSITIVITY
													OF FUZES THRU THE
													RAINFIELD AREA
													CLOCK TIMING REQD

(1.) D.S. MEANS DISPENSING STATION MEASURED FROM THE START OF THE RAIN TEST COMPLEX IN THE HAY DRAW AREA. (2.) TEST MANAGER WILL GIVE A 5 SEC. COUNTDOWN PRIOR TO EACH ROUND FIRED. (3) SYNCHRONIZE CAMERA CLOCKS WITH TRACK CONTROL.
(4.) BUNKERS REQ'D AT EACH CAMERA SITE FOR PROTECTION OF PERSONNEL. (5) CAMERA OPERATORS REQUESTED TO KEEP A LOG OF EVENTS (E.G. FRAME NUMBER VS. ROUND NUMBER.) (6.) DAYLIGHT ORIENTATION SHOT REQ'D FROM EACH CAMERA.
(7.) PROJECTILE APPROX. 12" LONG & 4" IN DIA.
(8.) USE NOTE 'A' ON POR.

FORM 4253 (7-29-77)

STATION	T.S. LOCATION	CAMERA TYPE	LENS SIZE	FPS	FILM Type	FILM Length	PROGRAM On	PROGRAM Off	COVERAGE SEGMENT Horiz.	COVERAGE SEGMENT Vert.	IMAGE SIZE Horiz.	IMAGE SIZE Vert.	ASSIGNMENT
F-2815	DS1750	K-38	24	One Frame	2424	125'	MANUAL		810'	405'	.022	.022	F-2815 (DS 1750)
	1000' South		INCH	Per Round	IR				⊥	⊥	IN/FT	IN/FT	View DS1345 Thru
													DS 2155 ⊥ To
													Fuze Trajectory.
													Used To Evaluate
													The Fuzes In The
													Rainfield Area And
													Target Face At
													DS 2100,
													Clock Timing Req'd
FX-1	DS 850	16mm F.F.	25	5000	B&W	450'	MANUAL		20'@	13.5'@	.0015	.006	FX-1 During Afternoon
		Nova	mm			(1 Roll			⊥	⊥	IN/INCH	IN For 4"D	Of Night Mission Rec'd
						Per Round)							5 Rounds For Purposes
													Of Determining The
													Projectile Velocity.
													Camera Generator
													And Target Board
													To Be Removed Be-
													Fore The Night Firings
													1000 ~ Timing Signal
													Gen. Req'd (L/A)

NOTES: (1.) FX-CAMERA TO BE USED FOR 5 ROUNDS ONLY IN AFTERNOON PRIOR TO NIGHT FIRINGS. (2.) FX-1 CAMERA WILL BE REMOTELY CONTROLLED FROM F-2814 BEHIND THE BUNKER. (3) BUNKERS TO BE IN POSITION ON L-1 DAY. (4) TARGET WILL BE TRANSPORTED & SET UP BY PROJECT. (TARGET WILL BE 16' LONG)

Page 2 of 6

Continuation Sheet of Form 4253

DYNALECTRON CORPORATION
land-air division

DOC PHOTO REQUIREMENTS

HIGH SPEED TRACK
OPTICAL PLAN

Oplan Series 63R-A | Project Title: M577 MTSQ FUZE TEST | Test Manager DON SEVERSON

J.O.N. 921CSY45 | L/A No. 0205 | Prepared By: BAGWELL | Date 7-31-80 | Checked By: [illegible] | Date 7-31-80 | Approved By: [illegible] | Date 8-1-80

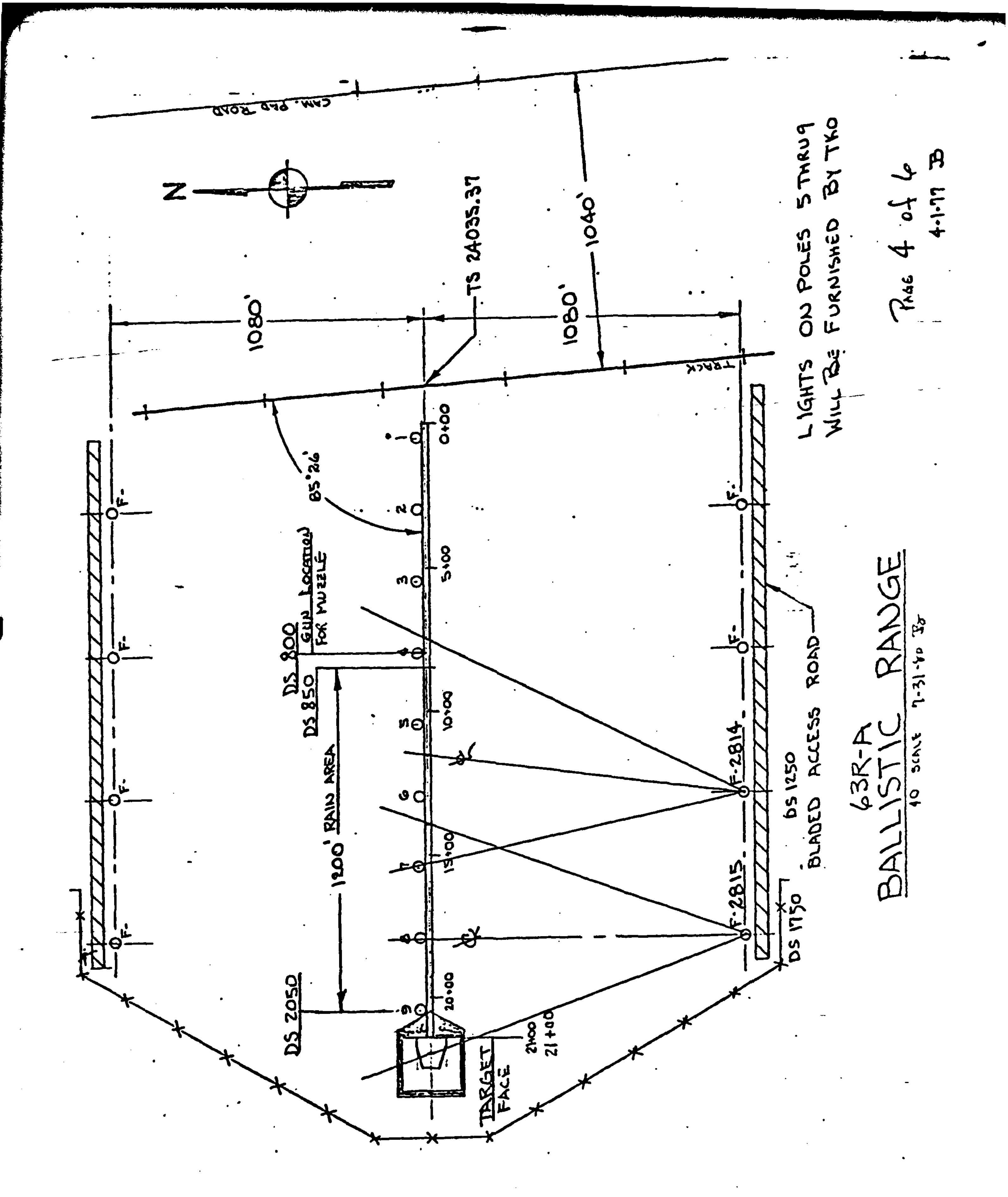
Still Photography — Not Req'd ( )
(X) 2¼ x 2¼ Pre-Post Run *
( ) 4x5 Pre-Post Run (B&W) (Color)
( ) Poloroid (B&W) (Color)
( ) 35mm Pre-Post Color Slides
( ) Blast-Off Shot (Color Only)
☐____Oncoming View ☐ ⊥ ☐____Rear

Motion Picture — Not Req'd (X)
( ) 16mm Pre-Post Run (Color)
( ) Tracking Cameras____Required (See TD-Below)
( ) Helicopter Tracking (See HT-Below)
( ) Other

Station / Camera Type	T.S. Location	Lens Size	FPS	Film Type	Film Length	Cov. Segment Horiz	Cov. Segment Vert	Image Size Horiz	Image Size Vert	Assignment

Notes:
* OR 2¼ x 2¼ ROLL FILM AS REQ'D BY TEST MANAGER.

FORM 4213 (7-29-77)

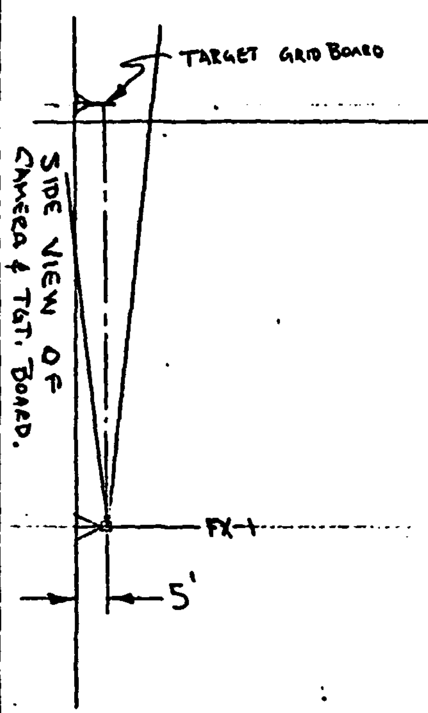

CAM. PAD ROAD
N
1040'
1080'
1080'
TS 24035.37
TRACK
85°26'
0+00
5+00
10+00
15+00
20+00
DS 800
GUN LOCATION FOR MUZZLE
DS 850
1200' RAIN AREA
DS 2050
TARGET FACE
2100
21+00
F-2814
F-2815
DS 1250
DS 1750
BLADED ACCESS ROAD
LIGHTS ON POLES 5 THRU 9
WILL BE FURNISHED BY TKO
Page 4 of 6
4-1-77 B
63R-A
BALLISTIC RANGE
40 SCALE 7-31-70

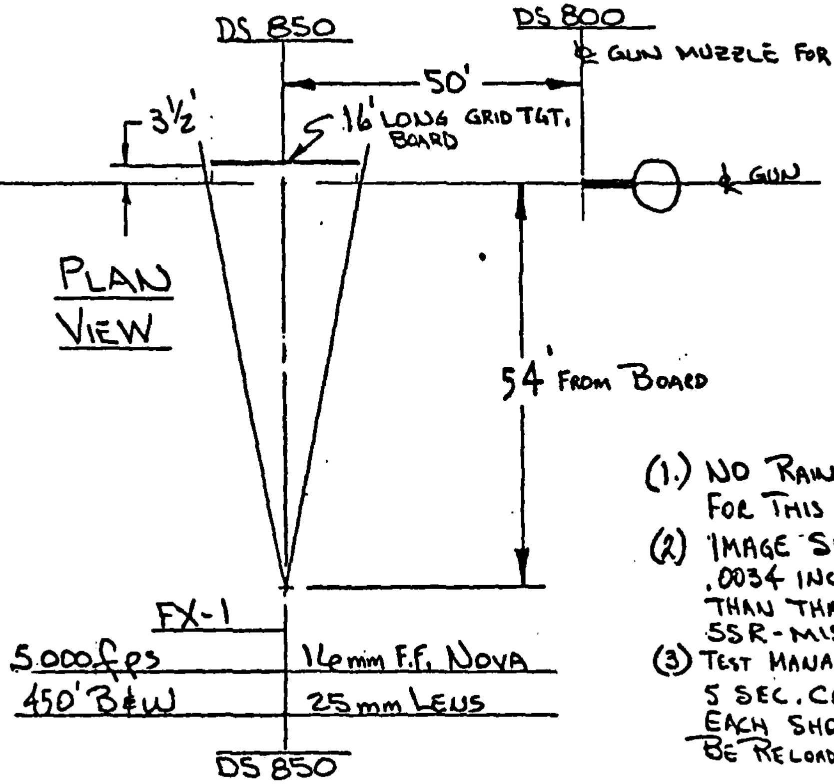
DYNALECTRON CORPORATION
land-air division

OPTICS INSTRUMENTATION PLAN

OPLAN SERIES: 63R-A TOP Nº O-7-7	DATE: 7-31-80	GENERATOR REQ'D: ONE

TS ______ TS ______ 30





(1.) NO RAW WILL BE REQ'D FOR THIS AFTERNOON FIRING.
(2) IMAGE SHEAR WILL BE .0034 INCH WHICH IS LESS THAN THAT OBTAINED ON SSR-MISSION.
(3) TEST MANAGER WILL GIVE A 5 SEC. COUNTDOWN PRIOR TO EACH SHOT. CAMERA MUST BE RELOADED AFTER EACH SHOT.

STATION	LOCATION	SPECIAL INSTRUCTIONS
FX-1	DS 850 54' SOUTH OF TARGET BOARD	ALIGN CAMERA(S) AS FOLLOWS: FX-1 ⊥ TO TGT. BOARD & 54' SOUTH, POSITION ℄ HOR. & VERT. OPTICS IN CENTER OF GRID BOARD. CAMERA HEIGHT APPROX 5' TO BE LEVEL WITH ℄ OF BOARD.

STATION	TURN-ON	TURN-OFF	TIMING REQ'D ☒ DIODE ☐ NEON 1000~
FX-1	T-3.0 SEC	OUT OF FILM	EVENT: FX-1 WILL RECORD 5 ROUNDS DURING DAYLIGHT HOURS PRECEEDING
	MANUAL		NIGHT MISSION, FOR PURPOSES OF DETERMINING PROJECTILE VELOCITY. (ONE
	(COUNTDOWN FROM T/M)		450' ROLL OF FILM PER ROUND FIRED.) CAMERA & GENERATOR TO BE MOVED
			OUT OF FIELD OF VIEW OF K-38 PRIOR TO NIGHT MISSION.

Form 4226 (6-5-74)

DYNALECTRON CORPORATION
land-air division

TIMING & PROGRAMMING REQUIREMENTS

INSTRUMENTATION SECTION
OPTICAL PLAN

Oplan Series	T.O.P. No.	Date Prepared	Launch Point	Scheduled For
63R-A	0-7-7	7-31-80	BALLISTIC RANGE	STARTING 12 AUG. '80

Station	T.S. Location	Offset	Turn On	Turn Off	Timing Required			Communications Required
					GT-2	Irig-B	Num Irig-B	

NO SUPPORT REQUIRED FOR THIS MISSION

Notes All Timing Amplifiers to be Diode unless otherwise specified.

Track Final Clear Time T-____Hour(s)____Min.

Timing-Programming Amplifier Ready Time T-____Hour(s)____Min.

Camera Turn On Time T-____Hour(s)____Min.

FORM4217 (Rev 2-13-78)

Prgn 6 of 6

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 6585TH TEST GROUP (AFSC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO 88330

REPLY TO
ATTN OF: TKO (Mr Severson, AV 349-2162)

9 SEP 1980

SUBJECT: Preliminary Data, 577 MTSQ Fuze Tests

TO: Commander, ARRADCOM
DRDAR-LCN-T
Bldg 61
ATTN: Mr Tom Perkins
Dover NJ 07801

1. Attached are three copies of the following data:

a. Muzzle velocity

b. I.R. film data

c. Volumetric rainfield calibrations

d. Wind velocity, temperature, and barometric pressure

You were previously given copies of the Operations Plan, Countdown, and Optical Instrumentation Plan.

2. A Test Summary Report containing all of the above information will be published in the future and forwarded to you.

FOR THE COMMANDER

Donald M. Severson

DONALD M SEVERSON
Test Manager
6585th Test Group/TKO

1 Atch
Data

63R MUZZLE VELOCITY ROUNDS

12 August 1980

ROUND NO	MUZZLE VELOCITY (FPS)
1	No data (lanyard hung)
2	2758
3	2807
4	2758
5	2827

HH20

M577 MTSQ FUZE TEST
RESULTS
FROM I.R. FILM DATA

DATE	ROUND NO.	FIRE TIME	FUZE - S/N	FUZE FUNCTION LOCATION
12 Aug 80	1	2243:42	557	No Indication
	2	2245:06	577 - 80	" "
	3	2245:46	577 - 81	" "
	4	2246:16	577 - 82	" "
	5	2246:50	577 - 83	" "
	6	2247:17	577 - 84	" "
	7	2247:50	557	" "
	8	2248:23	577 - 85	" "
	9	2249:01	577 - 86	" "
	10	2249:44	577 - 87	" "
13 Aug 80	11	2201:38	557	Target
	12	2202:17	577 - 88	"
	13	2202:53	577 - 89	"
	14	2203:33	577 - 90	"
	15	2204:09	577 - 91	"
	16	2204:45	577 - 92	"
	17	2205:18	557	"
14 Aug 80	18	2025:15	557	"
	19	2025:49	577 - 93	"
	20	2026:17	577 - 94	No Indication
	21	2026:43	577 - 95	" "
	22	2027:08	577 - 96	Target
	23	2027:38	577 - 97	"
	24	2028:09	557	"
	25	2028:45	577 - 98	"
	26	2029:12	577 - 99	"
	27	2029:38	577 -100	"
	28	2030:02	577 -101	"
	29	2030:39	577 -102	"
	30	2030:54	557	"
	31	2110:09	557	"
	32	2111:50	577 -103	No Indication
	33	2112:14	577 -104	Target
	34	2112:46	577 -105	"
	35	2113:29	577 -106	"
	36	2114:30	577 -107	"
	37	2114:58	557	Rainfield
	38	2115:20	577 -108	Target
	39	2115:52	577 -109	"
	40	2116:16	577 -110	"
	41	2116:43	577 -111	"
	42	2117:05	577 -112	No Indication
	43	2117:31	557	Target
	44	2118:02	577 -113	"
	45	2118:19	577 -114	Target*

HH21

DATE	ROUND NO.	FIRE TIME	FUZE - S/N	FUZE FUNCTION LOCATION
14 Aug 80	46	2118:47	577 -115	No Indication*
	47	2119:11	577 -116	Target*
	48	2119:33	577 -117	" *
	49	2119:53	557	Rainfield
	50	2216:15	557	"
	51	2216:40	577 -118	Target
	52	2217:01	577 -119	"
	53	2217:26	577 -120	"
	54	2217:51	577 -121	"
	55	2218:14	577 -122	"
	56	2218:39	557	Rainfield
	57	2218:58	577 -123	Target
	58	2219:17	577 -124	"
	59	2219:42	577 -125	"
	60	2220:02	577 -126	"
	61	2220:24	577 -127	"
	62	2220:46	557	Rainfield
	63	2221:07	577 -128	Target
	64	2221:25	577 -129	"
	65	2221:49	577 -130P	"
	66	2222:11	577 -131P	"
	67	2222:32	577 -132P	No Indication
	68	2222:58	557	Rainfield
	69	2223:18	577 -133P	No Indication
	70	2223:39	577 -134P	" "
	71	2223:59	577 -135P	" "
	72	2224:23	577 -136P	Target
	73	2224:45	577 -137P	"

*THESE ROUNDS HIT THE GROUND AT THE END OF THE RAINFIELD, JUST IN FRONT OF THE TARGET.

NOTE: ROUNDS 1-10 MISSED THE TARGET AND HIT THE BUNKER TO THE RIGHT SIDE OF THE TARGET. THE OTHER ROUNDS WHICH DID NOT INDICATE A FUZE FUNCTION MOST PROBABLY WERE BURIED IN THE BUNKER, SHIELDING THE FLASH FROM THE CAMERAS.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 6585TH TEST GROUP (AFSC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO 88330

.Y TO
1 OF: TKS (Mr Monfette, 5-2203)

ECT: 63R-A Ballistic Rainfield Calibration Results

TO: TKO (Mr Severson)

1. The following data are the Ballistic Rainfield Calibration results for the 63R-A 90MM Fuze tests conducted from 12 Aug - 15 Aug 80.

PRE-TEST RESULTS

Winds	Location	Nozzle Pressure	Avg Accumulation Rate
2k Down, 2 Cross	100-110 ft	3 PSIG	18.8 in/hr
2 Down, 1 Cross	110-120 ft	3 PSIG	25.7 in/hr
2 Down, .5 Cross	120-130 ft	3 PSIG	28.5 in/hr

POST DATE

Winds	Location	Nozzle Pressure	Avg Accumulation Rate
1K Down,.5k Cross	110-120 ft	3 PSIG	22.38 in/hr
1k Down, .5k Cross	120-130 ft	3 PSIG	24.3 in/hr

Phillip C Monfette

PHILLIP C. MONFETTE
Mechanical Eng/Rainfield System

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 6585TH TEST GROUP (AFSC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO 88330

PLY TO
TN OF: WE (Shipe, 2580)

27 August 1980

JECT: Environmental Data, M577 MTSQ Fuze Tests, 12-14 Aug 80

TO: TKO (Mr Severson)

1. Paragraph 4 and the Attachment give the environmental data taken during the M577 MTSQ Fuze Tests along the ballistic rainfield 12-14 Aug 80. This was the first test series where more than one anemometer was set up and available for real-time input to GO/NO GO decisions.

2. Temperature and pressure data were taken at the bunker next to the howitzer, except 14 Aug temperature and humidity data was estimated from the Holloman Base Weather Station. Cross-rainfield and along-the-rainfield wind component data were taken with Gill "UV" anemometers set approximately ten feet from the north edge of the rainfield at the following locations:

a. Station C: 200 feet west of the east end of the rainfield

b. Station B: 700 feet west of the east end of the rainfield

c. Station A: 75 feet east of the west end of the rainfield

A cross-rainfield wind component from the north was defined as positive, south negative. An along-the-rainfield wind component from the east is negative, west positive.

3. Due to time and other constraints, we were unable to a) get the Station B cross-rainfield wind component or Station A wind recorder working and b) perform a post-test anemometer calibration. As a result of this and a loss of power on the 14th, some of the wind data is missing. We estimate wind data accuracy at about ± .4 knot.

4. Temperature, humidity, and pressure data are as follows:

a. Shells 1-10: 72° F ± 3° F, 75% ± 5%, 875.8mb ± .2mb

b. Shells 11-17: 73° F ± 1° F, 81% ± 2%, 872.2mb ± .2mb

c. Shells 18-73: 73° F ± 3° F, 88% ± 5%, 871.4mb ± .3mb

John A. Shipe
JOHN A SHIPE, Major, USAF
Staff Meteorologist

1 Atch
Wind Components Data

WIND COMPONENTS FOR EACH HOWITZER SHELL
(Given in knots)

	Station A		Station B	Station C	
Shell #	Cross-Rainfield	Along-Rainfield	Cross-Rainfield	Cross-Rainfield	Along-Rainfield
1	-1.0	-1.5	-.8	-1.8	-2.7
2	-1.0	-2.0	-1.0	-1.0	-2.5
3	-.7	-1.5	-.8	-1.0	-3.0
4	-.5	-1.7	-.7	-1.2	-3.1
5	-.6	-1.8	-.4	-1.2	-3.3
6	-1.0	-2.0	-.7	-1.1	-3.0
7	-1.0	-2.0	-.7	-1.5	-3.3
8	-1.0	-2.0	-1.0	-1.4	-3.3
9	-.8	-1.5	-.8	-1.2	-2.9
10	-.7	-1.7	-.8	-1.0	-3.0
11	-2.5	.5	-2.5	-2.0	.5
12	-2.2	.7	-2.5	-2.4	.5
13	-2.5	7	-3.0	-2.0	.8
14	-2.8	5	-2.5	-2.0	.6
15	-3.0	.5	-2.3	-2.4	.6
16	-2.8	.5	-2.7	-2.0	.4
17	-2.8	.5	-2.7	-2.3	.4
18	.7	0	.4	.5	0
19	.5	0	.7	.4	0
20	.5	0	.6	.2	0
21	4	—	.6	0	—
22	.5	—	.6	—	—
23	.5	—	.6	—	—
24	.6	—	.7	.3	—
25	.6	—	.7	.5	—
26	.7	—	.7	.4	—
27	.6	—	.7	.4	—
28	.6	—	.7	.2	—
29	.6	—	.7	.1	—
30	.6	—	.2	—	—
31	—	-1.5	.3	—	—
32	—	-1.5	.4	-.2	0

WIND COMPONENTS FOR EACH HOWITZER SHELL (CONTD)
(Given in knots)

	Station A		Station B	Station C	
Shell #	Cross-Rainfield	Along-Rainfield	Cross-Rainfield	Cross-Rainfield	Along-Rainfield
33	.1	-1.6	.8	-.2	0
34	—	-2.0	1.0	-.3	-2.0
35	.4	-1.5	1.3	-.2	-2.3
36	.8	-1.0	1.1	.5	-3.3
37	.5	.8	1.0	.7	-2.4
38	1.4	—	1.5	.9	-2.5
39	1.5	—	1.0	1.0	-1.7
40	—	—	1.0	1.2	-1.0
41	1.2	—	1.0	1.2	-1.0
42	—	—	1.0	2.0	-1.0
43	—	—	1.3	1.1	-.9
44	—	—	1.8	1.1	-.8
45	—	—	1.7	.9	-.5
46	—	—	1.6	1.3	-1.2
47	—	—	.0	1.5	-1.5
48	—	—	.9	1.4	-1.5
49	—	—	4.0	2.7	-1.3
50	—	—	3.3	2.5	-1.5
51	—	—	2.7	2.2	-1.5
52	—	—	3.6	2.9	-1.4
53	—	—	3.2	2.0	-1.0
54	—	—	3.7	2.0	-1.0
55	—	—	4.7	1.7	-.9
56	—	—	3.9	2.5	-.5
57	—	—	4.0	2.5	-.8
58	—	—	2.8	3.0	-1.3
59	—	—	3.0	2.2	-1.2
60	—	—	3.0	2.7	-1.0
61	—	—	2.5	3.5	-.9
62	—	—	3.5	3.0	-1.0
63	—	—	2.5	3.7	-1.1
64	—	—	3.0	2.0	-1.0

WIND COMPONENTS FOR EACH HOWITZER SHELL (CONTD)
(Given in knots)

Shell #	Station A Cross-Rainfield	Station A Along-Rainfield	Station B Cross-Rainfield	Station C Cross-Rainfield	Station C Along-Rainfield
65	—	—	2.5	3.0	-.6
66	—	—	3.0	1.1	-.5
67	—	—	2.7	2.3	-.5
68	—	—	3.2	1.8	-.2
69	—	—	3.4	3.3	0
70	—	—	3.2	2.9	-.5
71	—	—	2.6	1.5	-.3
72	—	—	1.6	2.4	.0
73	—	—	2.3	1.5	-.3

3